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# BIOLOGY AND MEDICINE.[1]

BY WILLIAM H. WELCH, M. D., LL. D.

It is a great pleasure to bring hearty congratulations to the University and the city of Chicago upon the completion of the Hull Biological Laboratories. This University, the offspring of unexampled private munificence, marvellous in its birth and infancy, and clearly destined to great achievements for education, for science and for humanity, may well rejoice upon this occasion, but Miss Culver, by her beneficent gift, has earned the gratitude not of this University alone, but of all interested in the progress of the biological sciences. A gift of such magnitude as this one, devoted to "the increase and spread of knowledge within the field of the biological sciences" is of far more than any local significance. It must awaken the cordial interest far and near of those who understand the scope and meaning of the sciences of organic nature. What is here planned and has already been accomplished, gives assurance that the wishes of the donor and the expectations of others will be amply fulfilled, and that in these laboratories in unusual measure will knowledge of the forms and activities of living things grow and hence be diffused.

[1] Address delivered at the dedication of the Hull Biological Laboratories at the University of Chicago, July 2, 1897.

Laboratories are now so universally recognized as essential for the systematic study and advancement of all physical and natural sciences, that we can hardly realize that they are almost wholly the creation of the last three-quarters of the present century. With the awakening of scientific thought in Western Europe in the fifteenth and sixteenth centuries, natural phenomena again began to be studied by those methods of exact observation and experiment which had received their last fruitful application centuries before in the hands of the natural philosophers and physicians of Greece and Alexandria. For the purposes of such study, learned academies and societies were founded, botanical gardens were planted, explorations and collections of natural curiosities were made, apparatus was devised and individual investigators had their scientific workships. All of these material circumstances greatly promoted scientific inquiry and discovery, but with one exception they did not lead to the formation of laboratories freely open to students and investigators. The exception was the establishment of laboratories for the study of human anatomy.

It is of no little interest, both for the history of biology and for that of science in general, that the first laboratory for the training of students was the anatomical laboratory. For over six hundred years there has been at least some practical instruction in anatomy, and for over three hundred years there have existed anatomical laboratories for students and investigators. Until the end of the first quarter of the present century there was no branch of physical or natural science, with the exception of anatomy, which students could study in the laboratory. Only in this subject could they come into direct personal contact with the object of study, work with their own hands, investigate what lay below the surface, and acquire that living knowledge which alone is of real value in the study of natural science.

The era of modern teaching and investigating laboratories was ushered in by the foundation of one devoted to another of the biological sciences. In 1824 Purkinje established a physiological laboratory in Breslau which antedated by one year Liebig's more famous chemical laboratory in Giessen. This

latter, however, which is usually, and, as we have seen, not quite correctly, considered to be the first of modern teaching laboratories, exercised the determining influence upon the establishment and organization of scientific laboratories in general. The significance of Liebig's memorable laboratory is that it provided a place, furnished with the needed facilities and under competent direction, freely open to properly prepared students and investigators for experimental work in the entire field of the science to which it was devoted. Such an impressive illustration of the value of laboratories for instruction and research could not fail to be followed by other departments of science. In this movement for the establishment of laboratories, Germany has been from the beginning the leader, and by their instrumentality she has secured the palm for scientific education and discovery.

We owe especially to Louis Agassiz the introduction into this country, fifty years ago, of laboratory methods in biological study, but it is only within very recent years that nearly the whole field of biology has been represented among us by laboratories worthy of the name. To the small number of suitably equipped biological laboratories existing in this country those whose opening we are assembled to celebrate, make a most notable addition, unsurpassed, I believe, in construction, in equipment, in plan of organization, and in opportunities for scientific work.

Modern laboratories have completely revolutionized during the past half century the material conditions under which scientific work is prosecuted. They have been the great instrument of the unexampled progress of the physical and natural sciences during this period. Their educational value cannot well be overestimated. They impart, or should impart, to the student something of the scientific habit of thought which is no less valuable in daily life and in other pursuits than in science. At the present day no University can hold even a respectable place in the march of education and progress unless it is provided with suitable scientific laboratories, and it is one of the glories of this University that this conception prevailed and bore fruit at its inception. The establishment and sup-

port of good laboratories require large outlays of money, and it is chiefly this requirement which calls for endowments of Universities far surpassing anything needed but a few years ago. But the benefits to mankind derived from such endowments outweigh, beyond all computation, the money expended which, as has been truly said, is "a capital placed at a high rate of interest."

One sometimes hears the remark, and it is of course true, that large endowments, palatial buildings, splendid laboratories do not make a University. The breath of life, the vitalizing principle, must come from those, both teachers and students, who work within their walls. If the phenomena of nature could be learned by contemplation and by hearsay, that famous University which consisted of a log with Mark Hopkins at one end and the student at the other, might exist somewhere outside of the imagination. But knowledge of nature is not to be acquired otherwise than by observation and experiment, for which the facilities at the end of a log are somewhat inadequate. The great teachers and investigators are likely to be attracted to those Universities where the resources and opportunities for their special work are the most ample.

Laboratories are only workshops; that which is of vital importance is what is done within them. Provision has been made in the Hull Laboratories for the cultivation of all departments of what is ordinarily called biology. The domain of biology embraces all living things, both vegetable and animal. Of vital manifestations it is only some of the mental operations and doings of human beings which the biologist at present excludes from his survey, and even this self-sacrificing curtailment of his province may not be enduring.

The main directions of biological study relate to the forms and anatomical structure, however minute, of living organisms, to their functions or activities, to their developmental history, both individual and ancestral, to their systematic affinities and classification, and to their distribution over the globe in present and in former geological epochs. This vast field of study is far more than can be compassed by one man,

however versatile and industrious, or in one laboratory. It necessitates such specialization and subdivision of labor as is represented by these laboratories and by those appointed to conduct the work in them.

All that relates to the vegetable kingdom, whether it be anatomical, physiological or paleontological, is included under botany. The historical development of this science has been far more consistent and symmetrical than that of animal biology. In the latter the central position is appropriately occupied by zoology in the widest sense. Unfortunately the term zoology has not had the same comprehensive meaning in reference to animals that botany has in reference to plants, but there is a growing tendency, which I am glad to see is here recognized, to include under the designation "zoology" more and more of animal biology, and especially to discard the artificial distinction between zoology and comparative anatomy, a distinction which can be traced historically to the early development and exceptional position of human anatomy, to which I have already alluded. Not less important than the study of organized form and structure, and inseparably intertwined with it, is that of physiology, which concerns itself with the properties and actions of living beings. Subordinate to physiology, but still deserving recognition as a specialized biological science, is physiological chemistry, which is most fruitfully cultivated by one trained both as a chemist and as a biologist, who gives his whole time to the subject. The study of the structure and functions of the nervous system has become so specialized and has such important relations to psychology, that neurology has here received special recognition as a separate department. The same is true of paleontology, which forms a connecting link between biology and geology, and which has shed most valuable light upon fundamental problems concerning the origin and development of animals and plants.

There are some who see in the setting up of all of these divisions and subdivisions of biological science peculiar perils resulting from the severance of natural relations and loss of perspective. This is the familiar cry of the general worker

against the specialist, a cry which, however loudly uttered, will not be heeded. Where proper organization exists, I do not share these apprehensions. The principle of specialization and subdivision of labor has been the great factor in scientific progress. Whenever a body of scientific knowledge has reached a stage of development in which its extent is considerable and its problems and the methods of attacking them are special, it is convenient and proper to recognize it as a branch of science whose interests will be best furthered by workers specially trained to its service.

But while conceding to the fullest extent the practical benefits which attend the separate cultivation of different departments of biology, I would even more strongly emphasize the essential unity of the biological sciences. In essence these sciences constitute but one science, and the great service of the word "biology" in its present use is to embody this conception. The fundamental problems everywhere in biology are the same, the determination of the structure and the properties and the laws controlling them of living matter. In whatever department knowledge be gained as to these fundamental questions, it is a contribution to all departments of biology. The expansion of our knowledge brings closer together all physical and natural sciences, physics with chemistry, and both with biology. It is of incalculable advantage that the surfaces of contact between the different branches of biological study should be kept clearly in view, and that knowledge gained by one should be made readily available for others. Hence it seems to me that the general plan of organization of these laboratories, providing as they do for special development in all proper directions of biological study, while retaining the conception of biology as one science, is eminently wise.

It would be a hopeless task for me to attempt to indicate to you all of the more important questions in which biologists at the present time are especially interested, even if I were myself familiar with them all. They penetrate into all provinces of life and relate to such matters as the complex organization of cells, the problems of heredity and development, the causes

of variation in living organisms, the influence of physical and chemical agencies, and in general of environment, upon the behavior of living cells and organisms, the relations of micro-organisms to fermentation and disease, the finer architecture of the central nervous system, and countless other themes. An especially interesting and new direction of development, to which the biological department of this University has made important contributions, is the application of the experimental method to the solution of certain morphological problems. From this source we may reasonably expect valuable light to be thrown upon the great problems of development, variation and heredity, and thereby we may acquire a clearer and more accurate insight than we now possess into the factors concerned in organic evolution.

No branch of human knowledge exceeds in interest and importance the study of biology; none has made greater advances during this century of scientific progress; none is of more importance to human welfare; none has more deeply impressed modern philosophic thought. Biology has profoundly influenced man's attitude toward Nature and the views as to his own position in the scale of being. It has important bearings upon social and moral questions. With true religion it has no contest, whatever may have been its influence upon dogmatic theology. It reveals the marvellous fitness of organic nature, and it cultivates one of the finest human sentiments, the love of nature. Who but a biologist, who was also a poet, could have sung of the chambered nautilus?

> "Year after year beheld the silent toil
> That spread his lustrous coil;
> Still, as the spiral grew,
> He left the past year's dwelling for the new,
> Stole with soft step its shining archway through,
> Built up its idle door,
> Stretched in his last-found home, and knew the old no more."

To those who seek the practical utility of scientific study biology can show its triumphs, but here as elsewhere in science the important discoveries which have found useful applications have been made by the devotees of pure science rather than by those who make technical utility their guiding principle.

No more striking illustration of the practical benefits conferred by biological discoveries can be given than that derived from the investigation of those lowly micro-organisms which are partly our friends, the preservers of the very existence of life upon this globe, and in smaller part our enemies, the causes of infectious diseases. It would be a long story should I attempt to rehearse the useful discoveries in this domain; how Pasteur saved the silkworm industries of France by his studies of a microscopic parasite; how agriculture and dairies and industries concerned with fermentative processes have been benefited; how preventive inoculations have saved the lives of thousands of animals; how surgery has been revolutionized by Lister's application of Pasteur's discoveries; how the scientific study of immunity has opened up new vistas in preventive and curative medicine, as exemplified by the antitoxic treatment of diphtheria and preventive inoculations for rabies, which have led to the saving of untold thousands of human lives All of the money ever expended for the promotion of biological science has been repaid a thousand fold by the useful applications of biological discoveries, and in making this statement in this presence I trust that I shall not be thought for a moment to countenance that Philistine view of science which would estimate its value in money or in immediate practical utility.

I have already had occasion to touch upon another side of biology, which is not at present here provided for and which may not be so familiar to all as a biological science. I refer to pathology or the study of life in its abnormal forms and activities. This is the pure science of medicine as distinguished from the art of healing. It is just as truly a department of biology as is the study of normal life. The relations of pathology to practical medicine are so intimate that the broader conception of this science as a part of biology is not always appreciated. Nevertheless pathology may be cultivated as a science no more subordinated to practical ends than is any other natural science. Its subject matter is any living thing which deviates from the normal condition. Its province is to investigate abnormal structure, disordered function and the

causes of these abnormalities. Pathological biology must rest upon a knowledge of normal biology. Between these two great divisions of biology no sharp lines of demarcation can be drawn. The province of one encroaches at many points upon that of the other and they are capable of yielding each other mutual aid.

Although certain directions of pathological study can be followed in a University independently of a medical school, the natural environment of a pathological laboratory is the medical school and hospital, where it can obtain the necessary material for study. Here only can pathology flourish in its entirety.

At the exercises connected with the laying of the corner stones of these laboratories, President Harper uttered these significant words: "In laying these corner stones to-day we are laying the foundations of a school of medicine, for aside from the distinct work outlined in each department there is that great and important service to be rendered in the establishment of a school of medicine, the chief work of which shall be investigation." It will not therefore be out of place at the dedication of these laboratories if I say a few words concerning their relations to the proposed school of medicine and the need of such a school.

A university is the historical and proper place for the establishment of a medical school. Before there was a school of law at Bologna or of theology at Paris, there was a school of medicine at Salernum. For centuries all that there was of biology was to be found in the medical faculty. The union between medical school and university is of mutual advantage and each receives renown from the other. The distinction of great universities has often rested in no small measure upon their medical faculties, as witness such names as Johannes Müller, Virchow, DuBois-Reymond, Ludwig, Kölliker, to mention only a few biologists. The advantages to the medical school of this union are manifold. Among the more important of these may be mentioned the encouragement of research, the development of the scientific spirit and of university ideals, the proper maintenance of laboratories, contact with other departments of

science, economy of organization, and improved methods of instruction. To secure these advantages the union must be a real one. There is no saving grace in merely calling a medical school a department of a university. The medical school must be a vital, integral, co-ordinate part of the university. It should also be said in this connection that the granting of the doctor's degree is the function of a university and it is a usurpation for it to be assumed by independent medical schools responsible to nobody.

Medical science and art rest upon a knowledge of anatomy and physiology and these latter subjects are included in the special medical studies. But before undertaking these special studies it is in every way desirable that the students should have had a liberal education which includes a fair training in physics, chemistry and general biology with the ability to read French and German. You not only have here all that is requisite for the training preliminary to medical education, but you have in these biological laboratories the foundation of a medical school and a part of the superstructure. The usefulness of these laboratories, great as it is under existing conditions, would in my judgment be still further enhanced, especially in certain departments, by association with a medical school, and I need not emphasize the enormous value which the medical school would derive from them.

Not only this University but also the city of Chicago by its size and situation offers peculiarly favorable conditions for the foundation of a great medical school such as is here contemplated.

The present state of the science and art of medicine and of medical education renders especially urgent the claims of higher medical education. Medical science has made enormous strides during the last two decades. The present is a period of great and fruitful activity in medicine. New points of view have presented themselves. Problems of the highest importance to science and to humanity are awaiting only suitable opportunity and patient investigation for their solution. Methods of the laboratory are now applied to the practical study of disease for purposes of diagnosis, prognosis and treat-

ment. The practice of the healing art is a far more scientific and rewarding pursuit now than formerly. The great discoveries relating to the agency of micro-organisms in the causation of disease have given a firm basis to preventive medicine, which has as yet been able to utilize only a relatively small part of the available knowledge.

To the new conditions medical education has as yet only imperfectly adjusted itself. The great need of our medical schools is the establishment of thoroughly equipped and well organized laboratories and these require endowments which none in this country possess to any adequate extent and few possess at all.

While the primary aim of a medical school is to train practitioners of medicine and surgery, a great medical school should also advance the science and art of medicine. This art is becoming in increasing degree applied science, and it cannot be fully acquired without training in the biological medical sciences. I think that in a four years medical course, the first two years should be devoted to the study of the fundamental medical sciences, such as human anatomy, physiology, physiological chemistry, pharmacology, and pathology, and the last two to strictly professional training in practical medicine, surgery and obstetrics. It is one of the most important problems of medical education to maintain the proper balance between the purely technical training in the medical art and the study of the medical sciences. The cultivators of pure science in this or any other university need have no fear that the introduction of a medical department, organized in accordance with the present state of medical science, and to meet the existing needs of medical education, will bring any elements unsuited to the highest university ideals.

A suitably endowed medical school united with a university has to-day in this country unequaled opportunities to achieve success, and to confer a great service upon medicine and upon humanity. The need of such schools is everywhere recognized by the medical profession which would give to their establishment enthusiastic support.

For this purpose you will need large endowments. You will require a hospital with dispensary service. This need not be a very large hospital, but it should be entirely under your control. You will require additional laboratories of pathology, hygiene, pharmacology, and physiological chemistry. The teachers selected should be also investigators and those engaged in the scientific departments should be well paid, so that they can give their whole time to their subjects.

Medical education has not been a favorite object of endowment. Its needs are very imperfectly understood by the community, and our medical schools in the past have for the most part not been such as to encourage their support by private beneficence. But these conditions are changing as witness the names of such benefactors of medical education as Johns Hopkins, Vanderbilt and Mary Garrett.

Every one who has a patriotic pride in seeing this country take its proper place in the great movement forward in medical science and education, would rejoice to see here in connection with this University and in Chicago, such a medical school as I have endeavored to indicate. In no other direction could this University expand with greater promise of usefulness and renown, than in the promotion of the highest medical education. With the unbounded energy and will of this University and of this city, never content with what has been accomplished, however wonderful, but building for the future, it is not too much to say that you could attain something greater and better than has been hitherto achieved.

In conclusion, I desire to express the hope, indeed the conviction, that the Hull Biological Laboratories, which are now open for active work, will fulfil their high promise, will be guided by wisdom, will cherish high ideals, will contribute abundantly to knowledge, will be a centre to which students will wander from far and near, will be a fortress of sound biological thought and education.

# HAIR AND FEATHERS.

By J. S. Kingsley.

Birds and mammals, the highest groups of the whole animal kingdom, are sharply marked off from each other and from all other vertebrates by their tegumentary structures, feathers in the one group, hair in the other. Naturally structures so characteristic and evident as these have been made the subject of numerous investigations, but the more recent and more thorough studies have been published almost exclusively in German, and hence a summary of these may be acceptable to American readers. In the preparation of the following account the recent able review by Professor Keibel[1] has been freely used.

In the skin of the higher vertebrates two distinct portions may be recognized, differing in origin, structure, etc. The outer of these layers, the epidermis, arises from the ectodermal layer of the embryo, while the other layer, the cutis or dermis, has its origin in the mesoderm (mesenchyme). When fully developed the epidermis consists of a basal layer of cells resting on the dermis and receiving nourishment from it. By continual growth and consequent division, this basal layer produces other cells which come to lie outside it, but these more superficial portions, removed from any food supply, do not grow or divide, but die, dry up and become hardened into a horny cuticular layer which gradually wears away and is as constantly renewed from beneath. Outside of this cuticular layer comes a third layer, the epitrichium, only a single cell in thickness, which is lost in the mammals at a very early date, but which persists until a later stage in birds.

The deeper layer of the skin, the dermis or cutis, is largely composed of dense fibrous connective tissue, the fibres of which are tightly interlaced, and among them run nerves and

[1] Merkel und Bonnet's Ergebnisse der Anatomie und Entwickelungsgeschichte, 1896.

minute blood vessels, while here and there are developed muscle fibres of the smooth or involuntary type. This dermis is separated from the deeper tissues by a loose or aveolar connective tissue, in which fat is often developed to a considerable extent.

In the development of a hair slight differences are observable in different forms. In some the first phenomenon is the appearance of small papillæ in the dermis at the points at which hair is subsequently to be formed; in others the process of hair formation is initiated by changes in the epidermis, which only appear after the formation of the papillæ in the first mentioned types. This change consists in an elongation of the basal cells in a direction at right angles to the surface where the hair is to appear (fig. 1), the result being that the epidermis becomes slightly pushed into the dermis in these areas. Beneath these thickenings, there next follows a multiplication of dermal cells. As growth continues the inpushings increase in extent, while the dermal cells arrange themselves around the ingrowth to form a hair follicle with a slight projection, the hair papilla, at its base (fig. 2), the latter being supplied by a small capillary loop.

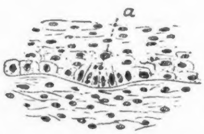


FIG. 1.—Section through the earliest stage of hair formation in a mouse, after Maurer. At *a* is shown the change in the basal layer of the epidermis.

So far the epidermal ingrowth has been solid, but now a circular depression appears, which, deepening with time, separates a central portion, the rudimentary hair, from a surrounding sheath (fig. 3). The relations will readily be seen from the illustrations, but a few words may be added to make all clear.

In figure 3 the hair is shown as a solid structure made up, as it protrudes from the skin, of three concentric layers; a central medulla, a middle so-called cortical layer, and an outer cuticular layer. Inside the

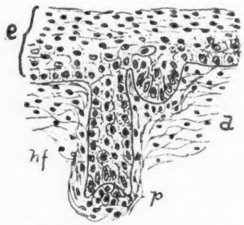


FIG. 2.—Later stages in the development of the hair in the mouse, after Maurer. On the right an earlier stage; on the left a later stage: *e*, epidermis; *d*, dermis; *hf*, hair follicle; *p* papilla.

follicle two other layers are seen, known by the names of those who first described them, the outer as Henle's layer, the inner as Huxley's layer. At one side of the follicle is shown the gland which secretes the oil, and which is clearly a derivation of the epidermis, while in several places are medullated nerve fibres connected with the sheath of the hair. The growing point of the hair is at the base of the follicle where the deeper epidermal cells, by constant division, produce other cells, which are added to the base of the hair, thus causing it continually to increase in length.

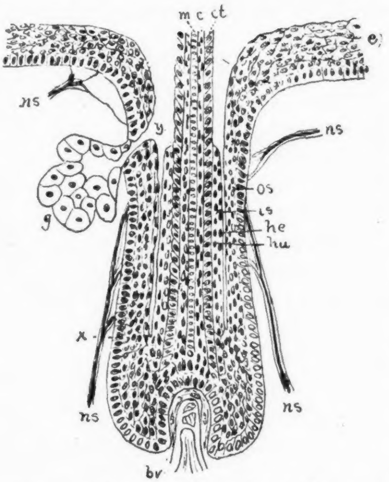


FIG. 3.—Diagrammatic section of hair and hair follicle, after Maurer. *bv*, blood vessel; *c*, cortical layer of hair; *ct*, cuticular layer; *e*, epidermis; *g*, sebaceous gland; *he*, Henle's layer; *hu*, Huxley's layer; these two composing *is*, the inner root-sheath; *m*, medulla; *ns*, secondary nerves; *os*, outer root-sheath; *x* and *y*, points regarded by Maurer as homologous with *x* and *y* of figure 13 with which this should be compared.

It may be well to say parenthetically that hair is not hollow; that the natural oil does not flow through it as through a tube, and that the singeing so strongly recommended by barbers will not close up any "openings through which the vital fluids of the hair escape."

When we look at any hairy surface the hairs appear to be arranged without any order. It is, however, interesting to note, in the light of what is to follow, that Maurer claims that the first hairs to be formed—at least in certain mammals—are arranged in a few rows, and that these rows have a definite position (fig. 4). With the later increase in the number of the hairs this regularity is lost, an intermediate stage showing the hairs arranged in groups, but it is not yet settled exactly how

much of the increase in number is to be explained by the division of hair follicles and how much by new formation. So, too, in the replacement of molted hairs it is doubtful whether a new papilla is formed, or whether the old papilla retains its functions.

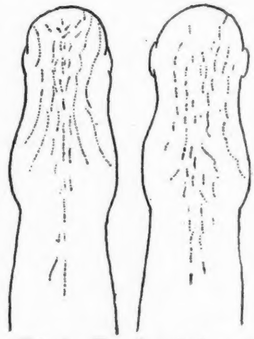

FIG. 4.—Two dorsal views of an embryo cat showing the early hair tracts. In the right hand figure the rows have been broken into patches. After Maurer.

When we analyze the phenomena of hair formation we find that the epidermis takes the initiative so far as cell multiplication is concerned. With feathers, on the other hand, the increase in cells begins in the dermis, the result being a slight elevation of the surface of the skin. Next the deeper cells of the epidermis form themselves into a double layer (fig. 5) and the whole is strikingly suggestive of a scale, in that one edge of the elevation projects more than the other. This outgrowth increases in extent until there results a cylindrical process protruding from the skin (fig. 6) with a very slight insinking, the rudiments of the future feather follicle, at its base. In this outgrowth, which is to give rise to the future down-feather, both dermis and epidermis may be recognized.

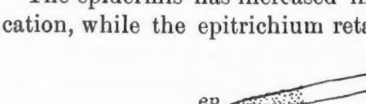


FIG. 5.—Early stage in the development of a down feathers in the pigeon. After Davies. *E*, epidermis; *ep*, epitrichium; *d*, dermis.

The epidermis has increased in thickness by cell multiplication, while the epitrichium retains its primitive condition.

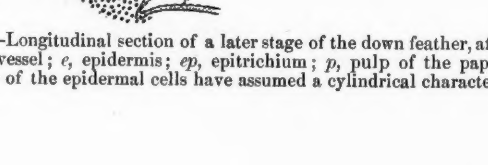


FIG. 6.—Longitudinal section of a later stage of the down feather, after Davies, *bv*, blood vessel; *e*, epidermis; *ep*, epitrichium; *p*, pulp of the papilla. The basal layer of the epidermal cells have assumed a cylindrical character.

The dermal portion, hereafter to be known as the pulp, has undergone modifications best understood by reference to a transverse section (fig. 7). It no longer has a smooth contour, but is produced in a radial manner into longitudinal ridges which nearly reach to the epitrichium. As a result of this the epidermal portion becomes divided into a corresponding number of rod-like structures, each of which becomes surrounded by a structureless ensheathing envelope produced by the basal layer of the epidermal cells.

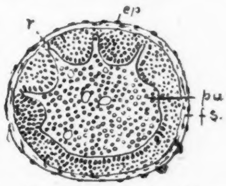


**Fig. 7.—Slightly oblique section of a young down feather of a chicken near the base. After Davies. *ep*, epitrichium; *fs*, feather sheath; *pu*, pulp; *r*, ridges of the pulp dividing the epidermis into a series of rod-like structures.**

The pulp now begins to retract towards the surface of the skin, leaving the whole outgrowth hollow, except for structureless partitions—the pith of the quill—here and there, produced by the retracting epidermis. The parts remaining external to surface of the body gradually dry up and become cornified, and, the epitrichial sheath breaking away, the epidermal rods just mentioned separate at their free ends, so that the well-known down-feather results, the basal, undivided portion of the outgrowth forming the small quill.

During this formation of the down-feather the follicle becomes much deeper, so that at length it presents considerable superficial resemblance to the hair follicle, and into it the dermal pulp retracts after the full formation of the down-feather is complete.

According to Davies all contour feathers are preceded by down-feathers, and even those cases which seem to form exceptions to this statement are found upon more accurate observation to accord with it. The statement may be put in another way: the germ of the definitive feather is a direct derivative of the germ of the down-feather. Let us now follow the development of a symmetrical contour feather.

With the retraction of the pulp (fig. 8) the follicle widens while the feather papilla enlarges so as to contain a much more considerable pulp, but in other respects it is closely similar to

the earlier down papilla except that it is seated in a follicle. There now occurs the same outgrowth of ridges from the pulp as before, dividing the epidermis in a similar manner, with the following exceptions: In the down papilla these ridges were parallel to the axis of the future feather; in the contour feather (fig. 9) they are oblique to that axis, the result necessarily being that the formations of a series of long slender processes—the future barbs—which are connected with an undivided portion, the shaft—on the so-called dorsal side of the papilla. Around all is developed a sheath as before.

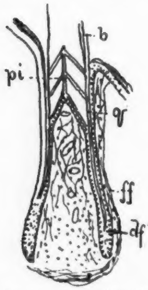


FIG. 8.—Longitudinal section through the shaft of a primary down-feather, after Davies. *b*, barbs; *df*, apex of the definitive feather germ; *ff*, feather follicle; *pi*, pith; *q*, quill.

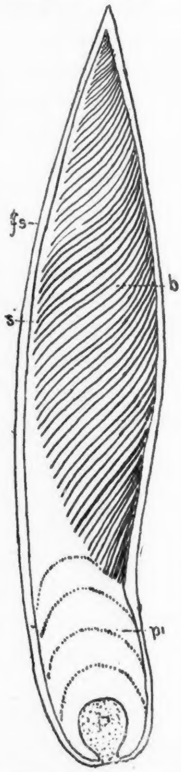


FIG. 9. — Diagrammatic representation of a definitive feather in its sheath, represented as a transparent object, after Keibel. *b*, barbs; *fs*, feather sheath; *p*, papilla; *pi*, pith; *s*, shaft.

This dorsal or shaft region demands a little closer attention. As seen in transverse section (fig. 10) the shaft shows on its inner edges longitudinal thickenings which, increasing in size, meet each other in differing ways in the different parts of the feather. A glance at figure 11 will explain this better than pages of description. The four sections are made at different levels, *A* being near the tip and *D* through the quill below the vane. Around each is the feather sheath and inside of each is the pulp cavity. In *A* the ingrowing edges of the shaft meet each other, and form a solid rod. Farther down, as in *B* and *C*, they include in the ingrowth a portion

of the pulp cavity thus making this portion of the shaft hollow; while in *D*, taken below the vane we have no barbs and only the hollow quill.

With the contour feather, as with the down feather there is the same retraction of the pulp and the same formation of pith as has already been described. After the feather is complete the retracted pulp remains quiet until about the time of the molt when it comes to the front again to form the new feather. The feather, the development of which we have been following, is as yet cyclindrical in shape and is still enclosed in the feather sheath. With the retraction of the pulp it dries and becomes horny as before, the sheath breaks away and the barbs by their elasticity straighten out and become arranged on either side of the shaft (see fig. 12) so as to form the well-known vane.

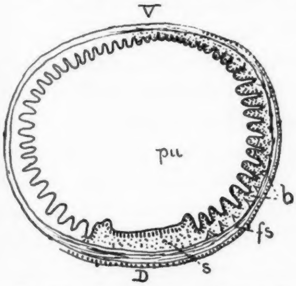


FIG. 10.—Section near the tip of a developing contour feather of a Canary, after Davies. *b*, developing barbs; *fs*, feather sheath; *pu*, pulp; *s*, sheath; *d* and *v*. dorsal and ventral.

There are here to be mentioned two points. The first is that the upper and lower surfaces of the contour feather do not

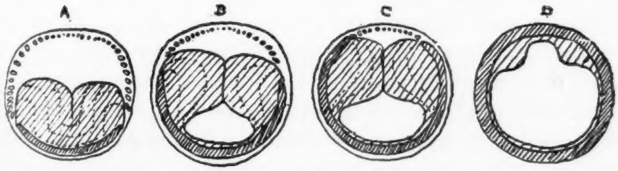


FIG. 11.—Four transverse sections through fig. 9 at different levels, *A*, near the tip; *D*, near the base.

correspond to the upper and lower surfaces of the papilla but rather to the inner and outer surfaces of the feather-forming epidermis, as may be seen by a comparison between figures 10 and 12. The other matter is this: With the withdrawal of the pulp from the feather there is no longer any nerve or blood

supply to the parts of the feather. The cells of which it is composed are dead and dry so that it seems impossible that any change can take place in it. The whole question of change in color of the fully formed feather was recently reopened by Mr. J. A. Allen who maintained that, once formed, the feathers do not change in their markings. The whole history of development seems to afford him full support. Yet this year the attempt has been made to show that feathers do change in their markings. In this, as the matter now stands, the burden of proof is upon those who support the possibility of change.

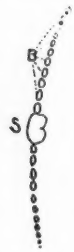


FIG. 12.—A section through a feather at the level of fig. 11 A, after the rupture of the feather sheath and the spreading out of the barbs (*b*) to form the vane; *s*, shaft.

Another aspect of the hair and feather question must now be taken up. How did these two structures come into existence? They certainly were not formed *de novo*, for it is one of the axioms—we had almost said—that all structures are to be traced back as modifications of pre-existing structures. If this be so, to what can these structures be referred?

Until very recently the attempt was made to show that hairs and feathers were homologous in origin. Thus the older students sought to find intermediate stages in the pin feathers, which are certainly hair-like in appearance; and to derive both hair and feathers from the Reptilian scale, a view which received much seeming support from the tarso-metatarsal scales of birds and from the scale-like feathers of the penguins, as well as from the scaly armor of pangolins, etc., on the mammalian side. The interested student will find all of these views ably and concisely summarized by Keibel; our space will not admit more than this reference to them. It may be said, however, that Davies, to whom we owe the most accurate account of the development of the feather declines to regard pin feathers as the simplest type of the avian tegumentary covering but rather as a retrograde condition; and farther, that he regards the scales upon the tarsal and digital regions of birds as secondary formations, agreeing in this with Jeffries.

If the Mammals be, like the birds, descended from the Reptiles then it is natural that we should look for those structures which have given rise to hairs in connection with the Reptilian integument. On the other hand there are those who believe that the Mammals spring direct from some Amphibian stock and to these the recent work of Maurer is full of interest. Maurer maintains that hair and feathers are not homologous structures. The feather, according to his view has been derived from the Reptilian scale while hair has arisen from the dermal sense organs of the Ichthyopsida as a result of a change in habits and conditions of life. As illustrating his views we have copied (fig. 13) one of his figures, a diagrammatic longiudinal section of a dermal sense organ of Triton after the metamorphosis, which should be compared with the diagram of the structure of the hair follicle and hair already given (fig. 3) the letters in each indicating the homologies recognized by Maurer.

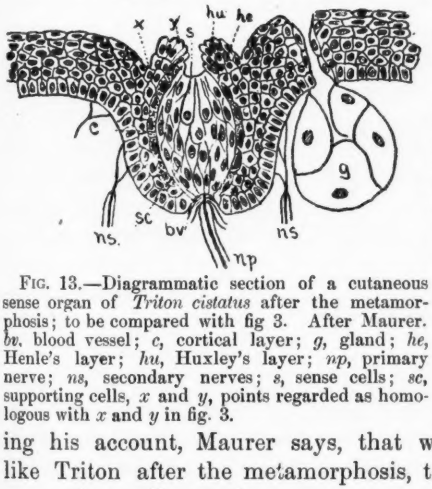


FIG. 13.—Diagrammatic section of a cutaneous sense organ of *Triton cistatus* after the metamorphosis; to be compared with fig 3. After Maurer. *bv*, blood vessel; *c*, cortical layer; *g*, gland; *he*, Henle's layer; *hu*, Huxley's layer; *np*, primary nerve; *ns*, secondary nerves; *s*, sense cells; *sc*, supporting cells, *x* and *y*, points regarded as homologous with *x* and *y* in fig. 3.

Slightly condensing his account, Maurer says, that when an Amphibian, like Triton after the metamorphosis, takes to the land, the supporting cells of the sense organs undergo a process of cornification and in this condition they show in the simplest form all of the parts of the hair and the hair follicle. " With the transfer to land, as is well known, the dermal sense organs lose their original function, itself dependent upon the presence of water as a surrounding median. In the axis of the hair lies the medulla, consisting of dry incompletely cornified cells. In these I recognize the modified remains of the sense cells.[2] The cortical layer is derived from the horny

[2] A view considerably different from those earlier advanced by him.

supporting cells and the cuticula from the enveloping cells of the dermal sense organs. In the epithelium around the sense bud both Henle's and Huxley's layers may be seen forming the inner root sheath as in the hair; while the connective tissue envelope forms a sense bud follicle just as the same layer forms the hair follicle. Even a papilla is frequently present in many Amphibia; (e. g., Cryptobranchus), containing a capillary network; but since the hair has lost its sensory function the axial nerve of the sense organ has degenerated.

We cannot go into the wealth of fact and comparison which Maurer has advanced in support of his position (which we may say in passing, has won the acceptance of Gegenbaur) but some of his statements and conclusions should be summarized here.

According to Maurer two types of organs are developed from the integument. The epidermoid organs are those structures which both phylogenetically and ontogenetically arise exclusively from the epidermis, and to which the dermis only enters when necessity for protection or nourishment arises. Here belong the tegumentary sense organs of the lower vertebrates as well as the "pearl organs" of the Teleosts, the femoral pores of the lizards, dermal glands and lastly the hairs of the Mammalia. Integumental organs in the narrower sense are those which have their first foundation in an alteration of the corium and always arise as an elevation of that layer, although the epidermis may be associated with it later and may secondarily acquire great prominence. Here belong the scales of fishes and reptiles, the feathers of birds and certain mammalian scales.

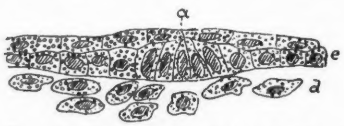


FIG. 14.—Section through the earliest stage of a developing sense organ of *Triton tæniatus*, after Maurer. At *a* the basal layer of the epidermis is changing in character, its cells becoming columnar, the first stage in their conversion into sense cells. Comparison should be made with fig. 1.

From this statement it is clear, if ontogeny be a test, that hair and feathers, are totally different structures; for as we have seen the development of hair begins with the epidermis; that of feathers as clearly with the dermis.

In the first appearance of the hair Maurer sees additional evidence in favor of his view. We have already alluded to the rows in which the earliest hairs are arranged. Maurer finds that the first tactile hairs to appear are arranged in the following rows: (1) supraorbital; (2) infraorbital; (3) zygomatic; (4) angular; (5) upper lip; (6) under lip; and (7) submental; and that these rows follow in a striking way, the course of the tegumentary branches of the tregeminal nerve. The other hairs are not irregularly arranged but are also in regular rows (see fig. 4) and, thinks Maurer, these rows are closely connected with the rows of sensory organs in the Amphibian skin. The grouped arrangement of hairs is secondary and the point of origin of a group is a single hair the follicle of which by budding gives rise to other follicles and hence to the hair group. Such a means of increase is found no where else than in the sensory organs of the Ichthyopsida.

It would be interesting did space permit to go farther into this subject and to take up other tegumentary structures. It is, however, hoped that this brief review will lead to the reading of Keibel's summary already referred to with its bibliography of over one hundred titles.

# BIRDS OF THE GALÁPAGOS ARCHIPELAGO: A CRITICISM OF MR. ROBERT RIDGWAY'S PAPER.

By G. Baur,

UNIVERSITY OF CHICAGO.

On the 30th of March, Mr. Ridgway published a paper on the "Birds of the Galápagos Archipelago,"[1] in which he makes the following remarks in regard to the genus Geospiza:

"Few genera equal the present one in the extreme modifications in the form of the bill, which in some species (*magnirostris* and *strenua*) is, perhaps, not excelled by that of any

[1] Proc. U. S. Nat. Mus. (No. 1116), Vol. XIX, p. 459-560, Pl. LVI-LVII, Washington, 1896.

member of the family Fringullidæ in its extreme thickness; in others (members of the so-called genus Cactornis) slender and decurved; in others very acute, with straight outlines, and, in others still, elevated and arched at the base. The most extreme forms are, however, so gradually connected by intermediate types, that there seems no possibility of satisfactorily subdividing the genus into two or more sections. The extreme modifications of the bill and some of the connecting forms are shown in the outline illustrations on plate LVII.

"The reduction of Cactornis to a synonym of Geospiza has already been made in my paper describing the new species of Galápagos birds in Dr. Baur's collection, in which is announced the discovery of species which absolutely bridge the previously existing gap between the so-called genera Geospiza and Cactornis, thus necessitating the suppression of one of those names (the latter, according to the rule of priority). Dr. Baur, who has had the advantage of studying these birds in life, disapproves of this, as the following extract from one of his letters will show: 'I should like to make a few remarks, if you will permit me, about Cactornis and Geospiza. You place the species of these two genera in one genus, Geospiza. I do not think that this is natural. Both have their peculiar representatives on the different islands, and if you place them together, this peculiar differentiation of each is lost sight of. Cactornis is more slender than Geospiza, and has many more black individuals. I would keep the two genera apart, and would not hesitate to place *Geospiza propinqua* in Cactornis.' I am quite willing to adopt Dr. Baur's views concerning the position of *G. propinqua,* which I had compared with *G. conirostris* (a true Geospiza); but, while admitting that it would be very convenient to recognize Cactornis if any definite characters could be found which will serve to separate them. The character which comes nearest to doing so, apparently, the relative width of the mandible between the bases of the rami to the length of the gonys, which is very much less in typical Cactornis than in true Geospiza. This greater compression of the bill even serves to trenchantly separate *Cactornis propinqua* from *G. conirostris,* some individuals of which are almost precisely alike in the lateral profile and measurements of the bill."

| | Albemarle I. | Indefatigable I. | James I. | Jervis I. | Duncan I. |
|---|---|---|---|---|---|
| *Nesomimus* | parvulus (Gould) | melanotis (Gould) | melanotis (Gould) | melanotis (Gould) | O |
| *Certhidia* | albemarli Ridgw. | salvini Ridgw. | olivacea Gould | spec. | spec. |
| *Pyrocephalus* | intercedens Ridgw. | intercedens Ridgw. | nanus Gould | nanus Gould ? | spec. |
| *Cactornis* | Spec. (fatigata ?) | fatigata Ridgw. | scandens Gould | spec. | spec. |
| *Geospiza* Series I. | strenua-magnirostris Gould | strenua Gould | strenua Gould | strenua-magnirostris Gould. | —— |
| *Geospiza* Series II. | fortis Gould (albemarli Ridgw.) | fortis Gould | bauri-fortis Ridgw. Gould. | fortis Gould. | fortis Gould |
| *Geospiza* Series III. | fuliginosa Gould | fuliginosa Gould | fuliginosa Gould | fuliginosa Gould | fuliginsoa Goul |
| *Camarhynchus* Series I. | variegatus Scl. & Salv. | variegatus Scl. & Salv. | variegatus Scl. & Salv. | | |
| *Camarhynchus* Series II. | affinis Ridgw. | psittaculus Gould | psittaculus Gould incertus Ridgw. | psittaculus Gould compressirostris Ridgw. | spec. |
| *Camarhynchus* Series III. | prosthemelas Scl. & Salv. | prosthemelas Scl. & Salv. | prosthemelas Scl. & Salv. | prosthemelas Scl. & Salv. | |
| *Tropidurus* | albemarlensis Baur | indefatigabilis Baur | jacobii Baur | jacobii Baur | duncanensis Baur |
| *Phyllodactylus* | galapagoensis Pet. | —— | —— | —— | —— |
| *Schistocerca* | melanocera Stål. | melanocera Stål. | melanocera Stål. | melanocera Stål | melanocera Stål. |
| *Euphorbia viminea* | albemarlensis (eypica) | | jacobensis | jervensis | |

| . | Barrington I. | Charles I. | Hood I. Gardner I. | Chatham I. | Tower I. | Bindloe I. | Abingdon I. |
|---|---|---|---|---|---|---|---|
| | barringtonensis | trifasciatus (Gould) | macdonaldi Ridgw. | adamsi Ridgw. | bauri Ridgw. | bindloei Ridgw. | personatus Ridgw. |
| | bifasciata Ridgw. | O | cinerascens Ridgw. | luteola Ridgw. | mentalis Ridgw. | spec. | fusca Scl. & Salv. |
| | O | carolinensis Ridgw. | O | dubius Gould. | O | spec. | abingdoni Ridgw. |
| | barringtonensis Ridgw. | intermedia Ridgw. | O | spec. | propinqua Ridgw. | spec. | abingdoni Scl. & Salvin |
| | —— | magnirostris Gould (Darwin) | conirostris Ridgw. | magnirostris Gould (Darwin) | pachyrhyncha Ridgw. | strenua Gould | strenua Gould |
| d | fortis Gould ? | fortis Gould | media Ridgw. | dubia Gould | O | fortis Gould ? | fratercula Ridgw. |
| ould | fuliginosa-parvula Gould | fuliginosa Gould | fuliginosa Gould | fuliginosa-parvula Gould | acutirostris Ridgw. | parvula Gould | parvula Gould |
| | | variegatus Scl. & Salv. (crassirostris Gould) | O | variegatus Scl. & Salv. | O | bindloei Ridgw. | habeli Scl. & Salv. |
| | spec. | psittaculus Gould | O | | O | | |
| | | prosthemelas ? Scl. & Salvin pauper Ridgw. | O | salvini Ridgw. | O | | |
| is | barringtonensis Baur | grayi (Bell) | delanonis Baur | bivittatus (Peters) | O | habelii Steind. | pacificus Steind. |
| | —— | baurii Garm. | —— | leei Cope | —— | —— | —— |
| a | melanocera Stål | melanocera Stål | literosa punctata Scudd. | literosa discoidalis Scudd. | literosa hyalina Scudd. | —— | —— |
| | barringtonensis | carolensis | | chathamensis | castellana | | abingdonensis |

I shall show now that the *Cactornis propinqua* Ridgway from Tower Island in the north and the *Geospiza conirostris* Ridgway from Hood Island in the south of the Archipelago have no relationship whatever. The distance between Hood and Tower is one hundred nautical miles. Mr. Ridgway arranges the different species of Geospiza (including Cactornis) in a single line, to show the gradual connection between the different forms. I can not agree with this.

My opinion is the following: All the plastic genera, which are represented only by a single species on each island, as Nesomimus, Certhidia, Pyrocephalus and Cactornis, show peculiar species on nearly every island. The same is true for the iguanoid lizard Tropidurus, the land tortoises, for Phyllodactylus of the Geckonidæ, of the genus Schistocerca of the Orthoptera,[2] and one of the most striking examples is offered by *Euphorbia viminea* Hook. fil. of the Euphorbiaceæ.[3]

But there are genera, like Geospiza and Camarhynchus, which have more than one species on one island—two or three, perhaps four.[4] How can we explain this? I think it is not difficult to answer this question. We simply have to imagine that already, before the splitting up of the Galápagos landarea into distinct islands, there existed at least 3 species of Geospiza and Camarhynchus, each of which became differentiated on the different islands. This shows at once that we can not arrange these species in one series, but in 3 parallel series. In some islands, as will be seen from the table, one or the other form of the 3 series may be missing. This conclu-

[2] Baur, G. The differentiation of species on the Galápagos Islands and the origin of the group. Biological lectures del. at the Marine Biol. Laborat. of Wood's Holl, summer session of 1894. Boston, 1895, p. 67–78.

[3] Robinson, B. L. and J. M. Greenman. On the Flora of the Galápagos Islands, as shown by the collections of Dr. G. Baur. Amer. Journ. Science, Vol. L, August 1, 1895, p. 135–149.

[4] I consider *Geospiza magnirostris* Gould and *G. strenua* Gould as unseparable. Species which are based on a single specimen like *Geospiza dentirostris* Gould, and the locality of which is unknown, are of no use. *Geospiza difficilis* Sharpe must be restricted to Abingdon. This leaves 3 species only for Charles. If there are more than 3 or 4 species of Geospiza said to occur on one island, I have no doubt that there is some mistake.

sion I reached the 16th of August, 1891, on James Island, and I have published it in 1892.[5]

If Geospiza was represented by three species, when all the islands were still in connection, each of these, after the segregation into different islands, developed its own races, which gradually became species. We always can recognize these three forms if they are present on a single island, and they never intergrade on the same island. We can distinguish three parallel series of Geospiza. First the large forms, represented by *Geospiza strenua* Gould; second, the medium-sized forms represented by *Geospiza fortis* Gould, and, third, the small forms represented by *Geospiza fuliginosa* Gould. The same is true for Camarhynchus. The table shows these different series.

I shall now make a few remarks about the birds from Charles, Hood, Barrington, and South Albemarle, which were contained in a box which disappeared in Guayaquil. The loss is not quite so unfortunate as stated by Mr. Ridgway. He remarks that it contained more than forty land birds from the southern part of Albemarle Island, but this statement, as will be seen from the list which I now give, is not correct. The only two species of birds which are lost are two specimens of Camarhynchus, and the new species of Nesomimus from Barrington Island, of which accidentally no alcoholic specimens were preserved. All the other species contained in the box are represented by alcoholic material.

List of lost specimens from Charles, Hood, Barrington and South Albemarle, and the number of alcoholic specimens preserved :

CHARLES ISLAND.

2 *Dendroica aureola* (Gould), 5 in alcohol.
6 *Geospiza fortis* and *fuliginosa* Gould, 33 in alcohol.
26 *Cactornis intermedia* Ridgw., 8 in alcohol.
11 *Camarhynchus.*
2 *Myiarchus magnirostris* (Gould), 3 in alcohol.

[5] Baur, G. Ein Besuch der Galápagos Inseln. Biolog. Centralbl. Bd. XI, 1892, p. 248–249.

3 *Pyrocephalus carolensis* Ridgway, 3 in alcohol.
6 *Coccyzus melanocoryphus* Viell.
2 *Nesopelia galapagoensis* (Gould).

HOOD AND GARDNER ISLANDS.

10 *Nesomimus macdonaldi* Ridgw., 1 skin, 9 in alcohol.
1 *Dendroica aureola* (Gould), 2 in alcohol.
6 *Certhidea cinerascens* Ridgw., 5 in alcohol.
7 *Geospiza* sp.; 10 *Geosp. conirostris* Ridgw., in alcohol.
13 *Geospiza fuliginosa* Gould, *in alcohol.*
1 *Myiarchus magnirostris* (Gould), 7 *in alcohol.*

BARRINGTON ISLAND.

11 *Nesomimus* n. sp.
3 *Dendroica aureola* (Gould), 2 in alcohol.
1 *Certhidia bifasciata* Ridgw., 3 skins from alcoholic specimens.
4 *Geospica*, 11 in alcohol.
7 *Cactornis barringtonensis* Ridgw., 3 skins from alcohol, 1 alcoholic.
2 *Camarhynchus* spec.
2 *Myiarchus magnirostris* (Gould), 4 in alcohol.

SOUTH ALBEMARLE ISLAND.

3 *Nesomimus parvulus* (Gould), 6 skins and 2 in alcohol.
6 *Dendroica aureola* (Gould), 6 in alcohol.
3 *Certhidea albemarlei* Ridgw., 2 skins, 2 in alcohol.
15 *Geospiza* (No. 316, large black; No. 336 large black, fine; No. 358,366, large black); (3 medium size, 8 small).
6 *Geospiza strenua* Gould, in alcohol.
10 *G. fortis* Gould in alcohol.
44 *G. fuliginosa* Gould in alcohol.
8 *Camarhynchus* (3 large, 5 small), 11 in alcohol.
6 *Cactornis fatigata* Ridgw., 6 in alcohol.
2 *Cactornis productus* Ridgw., 2 skins are preserved.
4 *Myiarchus magnirostris* (Gould), 2 in alcohol.
3 *Pyrocephalus intercedens* Ridgw., 1 skin preserved, 8 in alcohol.

2 *Himantopus mexicanus* (Müller), 2 skins are preserved.
1 *Coccyzus melanocoryphus* Vieill.
1 *Nesopelia galapagoensis* (Gould).

## Additions to the List of Birds Given by Ridgway for the Different Islands.

### ALBEMARLE ISLAND.

Ridgway enumerates 35 species from Albemarle, and remarks: "As Dr. Baur and his associate, Mr. Adams, collected more than forty species in South Albemarle, there are, at least, twenty-five species found there which are, as yet undetermined. I cannot support this statement. Ridgway himself names 33 species collected by us. The following have to be added : *Progne modesta* Néboux, *Coccyzus melanocoryphus* Veillot, *Fregata aquila* (Linn.), *Ardea herodias* Linn., *Phoenicopterus ruber* Linn., *Nesopelia galapagoensis* (Gould), *Larus fuliginosus* Gould, *Aestrelata phaeopygia* Salvin., *Procellaria tethys* Bonaparte.

The large white heron, of which I saw four specimens in South Albemarle and one in East Albemarle opposite Cowley Island, is certainly not a white phase of the large gray heron, but *Herodias egretta* (Gmelin). I have observed different specimens of *Ardea herodias* (Linn.) on South Albemarle. We have therefore, in all, 42 specimens of birds on Albemarle, and I do not believe that this number will be much increased, at least in the land birds, by further examination.

### BRATTLE ISLAND.

This very small island is very close to South Albemarle. Besides *Sula nebouxii* Milne-Edwards and *Creagrus furcatus* (Néboux), *Fregata aquila* (Linn.) breeds there. There are also a few small land birds (Geospiza).

### DUNCAN ISLAND.

To the 9 species mentioned by Ridgway the following have to be added. *Cactornis pallida* Scl. and Salv. (?) besides the black *Cactornis* sp.; *Progne modesta* (Néboux), *Asio galapagoensis* (Gould), *Fregata aquila* (Linn.), *Pelecanus californicus* Ridgway, *Sula nebouxii* Milne-Edwards; *Anous galapagoensis* Sharpe, *Aestrelata phaeopygia* Salvin, *Procellaria tethys* Bonaparte.

CHARLES ISLAND.

*Arenaria interpres* (Linn.); *Haematopus galapagoensis* Ridgw., *Oceanites gracilis* Elliot).

HOOD ISLAND.

*Fregata aquila* (Linn.) and *Phaëthon aethereus* Linn.

GARDNER ISLAND,[6] NEAR HOOD.

*Nesomimus macdonaldi* Ridgw., *Certhidia cinerascens* Ridgw., *Geospiza conirostris* Ridgw., *Geospiza fuliginosa* Gould, *Haematopus galapagoensis* Ridgw., *Nyctanassa violacea* (Linn.), *Anous galapagoensis* Sharpe.

STEEP ROCKS BETWEEN GARDNER AND HOOD.

*Creagrus furcatus* (Néboux), breeding.

CHATHAM ISLAND.

*Cactornis pallida* Scl. and Salv., possibly a new species; *Phaëthon aethereus* Linn., *Aestrelata phaeopygia* Salvin, *Procellaria tethys* Bonaparte.

BARRINGTON ISLAND.

*Progne modesta* (Néboux), and between Barrington and Indefatigable, *Creagrus furcatus* (Néboux), *Phaëthon aethereus* Linn. and *Diomedea* spec.

INDEFATIGABLE ISLAND.

*Ardea herodias* Linn., *Pelecanus californicus* Ridgw., *Oceanites gracilis* (Elliot).

NEAR SEYMOUR ISLANDS,

Forming the most northerly point of Indefatigable: *Creagrus furcatus* (Néboux), *Phaëthon aethereus* Linn. and *Diomedea* spec.

JERVIS ISLAND.

*Geospiza strenua-magnirostris* Gould; *G. fuliginosa* Gould, *Cactornis pallida* Scl. & Salvin, *Buteo galapagoensis* Gould, *Pele-*

[6] This is not Gardner Island, which is a small rock east of Charles Island. This fact shows at once that the *Nesomimus* found here is not *N. trifaciatus* (Gould) as supposed by Ridgway, p. 478, p. 481, but *N. macdonaldi* Ridgw. The specimens are not lost.

*canus californicus* Ridgw., *Sula nebouxii* Milne-Edw., *Larus fuliginosus* Gould, *Anous galapagoensis* Sharpe, *Nesopelia galapagoensis* (Gould).

JAMES ISLAND.

*Pelecanus californicus* Ridgw., *Creagrus furcatus* (Néboux), (Sullivan Bay, N.-E. end), *Spheniscus mendiculus* Sundevall.

TOWER ISLAND.

*Haematopus galapagoensis* Ridgw., *Butorides plumbeus* (Sundev.), *Phaëthon aethereus* Linn. Mr. Ridgway states p. (600) that there were no specimens in tbe Baur-Adams collection; this is not correct; six fine skins were secured.

BINDLOE ISLAND.

*Camarhynchus bindloei* Ridgw., which was based on our specimens, is placed in Habel's column. My list is: *Nesomimus bindloei* Ridgw., *Dendroica aureola* (Gould), *Certhidia* spec., *Geospiza strenna* Gould, *Geospiza fortis* Gould, *Geospiza parvula* Gould, *Cactornis assimilis* Gould, *Camarhynchus bindloei* Ridgw., *Myiarchus magnirostris* (Gray), *Pyrocephalus* spec., *Asio galapagoensis* (Gould), *Buteo galapagoensis* (Gould), *Fregata aquila* (Linn.), *Pelecanus californicus* Ridgw., *Sula nebouxii* Milne-Edw., *Sula brewsteri* Goss, *Nesopelia galapagoensis* (Gould), *Haematopus galapagoensis* Ridgw., *Nyctanassa violacea* (Linn.), *Arenaria interpres* (Linn.), *Larus fuliginosus* Gould.

ABINGDON ISLAND.

Besides *Nesomimus personatus* Ridgway, the only bird mentioned as ascertained by us, the following species were collected: *Certhidia fusca* Scl. and Salv., *Geospiza fratercula* Ridgw., *G. parvula* Gould, *Cactornis abingdoni* Scl. and Salv.; and the following birds were observed: *Buteo galapagoensis* (Gould), *Fregata aquila* (Linn.), *Pelecanus californicus* Ridgw., *Butorides plumbeus* (Sundevall), *Creagrus furcatus* (Néboux).

One set of the Baur-Adams Collection is at Clark University, Worcester, Mass., but the bulk of the collection has gone to the Zoological Museum at Tring.

# THE ADVANCE OF BIOLOGY IN 1895.

BY C. B. DAVENPORT.

The publication of *L'Année biologique* for 1895, which is described in another column, gives us an opportunity to make use of the admirable summaries of the chapters to summarize still further the advance of general biology in 1895.

*Cytology.*—The group of unnucleated organisms was still further diminished by Nadson's discovery in Cyanophyces of chromatin-like granules diffused throughout the cell, but arranging themselves during cell division in a way recalling karyokinesis. The idea of the permanent nature of the centrosome in the cell was strengthened by finding it in resting cells of many plant and animal tissues. The identity of centrosome and nucleolus in the infusorian *Spirochona* was insisted upon by Balbiani.

In the study of cell-division we find the year characterized by the variety of material employed—the attempt to build up a broader comparative knowledge upon the basis of well-studied types. The nuclear origin of the spindle was strongly maintained by Strasburger and others against the prevailing view. New variations in the method of splitting of the chromosomes were described. The mechanical (rather than the magnetic or chemotatic) explanation of the intracellular movements seemed to gain favor. The nature of the archoplasm, whether a part of the cytoplasm or different, was left in debate. New intermediate conditions uniting direct and indirect nuclear division were described and the great variety in the karyokenetic process was becoming generally recognized.

*The sexual products and fecondation.*—The question of chromatic reduction before the introduction of new chromatin by fertilization attracted many workers, and new data were obtained on the number of chromosomes in different species, the time at which reduction takes place and the details of the method. New methods of formation of the tetrads by conjugation were described by Wilcox, Calkins and others.

In our knowledge of *fecondation* great advance was made, largely by American workers. The derivation of the archoplasm of the fertilized egg exclusively from the sperm was confirmed upon many organisms; but Wheeler found in Myzostoma a case of the persistence of the archoplasm of the ovum only. The independence of the nuclear matter derived from the two germ cells united in fecondation was shown by Rückert to be indicated in Cyclops by the bilobed condition of the nucleus, even to the period of formation of the germ layers.

*Parthenogenesis.*—The accepted view that the unfertilized hen's egg may go through the early cleavage stages was shown by Barfurth and by Lau, independently, to rest upon errors in observation.

*Ontogenesis*—The contributions to the preformation-epigenesis controversy were among the most important of the year, pointing to a common ground for both sides, one, consequently, which probably lies near the truth. Driesch and Morgan, opponents of Roux's form of the theory of preformation, found in the Ctenophore an organism in which, when one of the two blastomeres is isolated, the other develops into a partial larva. This indicated a degree of preformation, but not the degree held by Roux; for, first, more than half of the larva was produced from the $\frac{1}{2}$ blastomere, and, secondly, when a piece was cut out of the fertilized but unsegmented egg, there was still a defect in the larva. The conclusion was: There is a rough preformation in the *cytoplasm*, but not, in addition, a qualitative divison of the nucleus as Roux supposes. On the other hand, Zoja found that a whole medusa developed from even a $\frac{1}{16}$ blastomere. We must recognize, consequently, a series in the capacity of developing a whole from a part, of which the medusa occupies one extreme and the ctenophore the other. Studies on amphibian eggs were made by Morgan, who found that half or whole embryos may be obtained from the $\frac{1}{2}$ blastomere, according as the contents of the egg preserve their normal positions or become intermingled by inverting the egg, and by Herlitzka, who found that the isolated $\frac{1}{2}$ blastomere of Triton develops like the entire egg. All the facts seemed to

point to a combined action of epigenesis and evolution in development.

The limiting size of the egg consistent with development was studied by Morgan, who found that one-fiftieth of an uncleft echinoid egg would develop, and by Loeb, who believed one-eighth of the total mass of the egg is necessary to the formation of the pluteus, while, in the presence of nucleoplasm, the very smallest quantity of cytoplasm is capable of growth and organization.

The theory that development is controlled by responses to stimuli was extended by Herbst and by Davenport to particular developmental processes. Roux brought forward his observations on the migration of isolated blastomeres with reference of each other—cytotropism; these migrations resembling those of zoospores towards and from each other (Hartog, Sauvageau). Advance was made in interpreting, on the ground of functional activity, the details of the form of the skeleton (Hirsch) and especially of the joints (Tornier).

*Teratogenesis.*—Double monsters were produced in frogs by inversion, which mixes up the contents, and in echinoids, by immersing the egg in a salt solution and thereby producing an "extraovat." The effects of low temperature upon development were studied in detail upon frogs and the chick; magnetism was shown again to have little or no effect upon development, while electricity has (Windle); abnormal density of solutions caused spina-bifida and other abnormalities in the tadpole (Hertwig, Gurwitsch). The capacity for development of enucleated egg-fragments into which a spermatozoan has penetrated was reasserted, as a result of new studies, by Boveri.

*Regeneration.*—Progress was made along three lines: the distribution of the capacity for regeneration, the comparison of regeneration and ontogeny, and the explanation of regeneration. As for the distribution of the regeneration capacity, new cases were described of the regeneration of internal organs (spleen of rabbit, liver of mammals)—not subject to accidental amputation. Failure to regenerate was reported of the thyroid gland and nerve cells in vertebrates. Experiments revealed a capacity for regeneration in the nervous system of earthworms,

the trunk segments of pantapods, and the body of ascidians. It became clearer that regeneration may proceed along very different lines from normal ontogeny—Wolff found the crystalline lens regenerating from the edge of the iris instead of the outer skin. Girard found that well-fed and much exercised tritons regenerate polydactylic feet.

Concerning the cause of regeneration, Nussbaum concluded that both regeneration and heteromorphosis depend upon indifferent cells in the body; Loeb suggested that regeneration depends upon special organogenic substances (Sachs); and Rauber compared in much detail organic regeneration to that of a crystal and believed a causal relation to lie behind the similar phenomena.

*Grafting.*—This year will be remembered as that in which Born published the results of his marvelous experiments on uniting bits of tadpoles belonging even to different families. Important also are the experiments of Wetzel who obtained from his grafts of hydra additional evidence for the polarity theory.

*Polymorphism, metamorphosis and alternation of generations.*—Advance was made (1) in the interpretation of many varieties as polymorphic forms; (2) in the determination of polymorphic forms by external conditions, and (3) in the discovery of a hidden alternation of generations in organisms. For the first, Coutagne showed for molluscs and Standfuss for mosses that similar varieties, due to the same causes, recur so frequently in different species that a few suffixes applied to the different specific names will suffice to designate all varieties. As for the second, Dietel showed that, in the Uredineæ, the succession of aecidio-, uredo- and teleutospores may be varied at will; Wasmann got intermediate polymorphic forms in ants by intermediate food conditions, and Bachmann modified, by changing the character of the substratum, the form of the sporangia of *Thamnidium.* As for the third, the idea of Strasburger (1894) was developed by others, so that the theory now seems well formulated that, as in the vascular cryptogams and the phanerogams, so also in all animals there is an alternation of generations, the sexual generation including the

four cells arising from the oögoumni—a rudimentary generation corresponding to the rudimentary sexual generation of angiosperms—and a non-sexual generation, which comprises the soma, each of whose nuclei has double the number of chromosomes found in the sexual generation.

*Correlation.*—The development of the doctrine of internal secretions was the most important contribution of this year to the theory of correlation. Especially were the effects on other organs of the removal of the sexual glands, the thyroid, the superrenals, and the digestive glands carefully studied; and the obliteration of these effects, by feeding extracts of the tissues, observed. The specific action of one part of the organism upon the other parts was being unravelled.

*General morphology and physiology.*—This year witnessed the memorable discussion between A. Sedgwick and Bourne as to the morphological value of "cells," which served to emphasize their physiological significance. To the subject of budding we have the contributions of Chun, who showed that, in the medusæ, both layers of the bud may be derived from one layer only (the ectoderm); thus another blow was dealt to the germ layer theory.

Especially memorable was the year for the appearance of Verworn's "Allgemeine Physiologie," which, in one leap, gave scientific standing to that subject, and of LeDantec's "La matiére vivante," much lèss extensive, but in the ground it covers, more profound; both works are dominated by the idea of the chemical nature of vital phenomena. The numerous papers on general physiology related to various subjects, especially general cell-physiology, muscle contraction, phagocytosis, effect of external agents on organisms, geotropism (Czapek), heliotropism, thermotropism (Mendelssohn), nutrition, cell respiration (Loeb and Hardesty), immunity, toxines and ferments.

*Heredity.*—The year saw much discussion of the inheritance of acquired characters and the theory of heredity, but little progress. The experiments of Charrin and Gley afforded another example of transmission (but rare and incomplete) to the first generation of the effects of vaccination. Hyatt pub-

lished in full his palæntological evidence that an impression in the shell of fossil Ammonites, due to crowding of coils, persists in (abnormally) uncoiled species. A masterly discussion of the whole question of inheritance of acquired characters appeared this year in Romanes' "Post-Darwinian Questions."

*Variation.*—If little new was added to our knowledge of heredity, such was by no means the case with variation. New facts were acquired, new methods of study employed, new experimental investigations made to determine its cause.

Osborn classified variations as ontogenetic (and either gonagenic, gamogenic, embryonic or somatogenic) and phylogenetic. Scott distinguished between individual variation (of ontogenetic value only) and mutation (of phylogenetic value).

Mehnert showed that variation occurs as abundantly in embryos as in adults. Eigenmann showed that in certain fishes the variants above the mode are more abundant than those below, and that individual variation is greatest where the number of species is greatest. The extraordinary variation of medusæ was investigated by Browne.

The development of the mathematical study of evolution, for which this decade will ever be famous, took a great stride in the publication of Pearson's "Skew Variation," by which methods of measuring unsymmetrical variation curves, their variability and their skewness were given. Since most biological curves are skew curves, this method greatly extends Galton's, which was applicable only to symmetrical curves. DeVries studied quantitatively a case of dimorphism in plants, and Weldon investigated selection in crabs.

Among the studies on the causes of variation may be mentioned the experiments of Vernon on echinoderm larvæ; of Weismann, Standfuss, Ris and, especially, Fischer (similar effect on heat and cold), upon lepidoptera; of Bonnier on plants subjected to electric light (producing excess of chlorophyll and scragged form); and of Goebel, who found that when cacti with foliaceous stems were grown in the dark the stems became rounded. Davenport and Castle found that tadpoles have the capacity for self-adaptation to heat.

As for variation due to internal causes, Meyer determined that despite its fewer chromosomes, *Ascaris univaleus* is as variable as *A. bivalens*, which is opposed to Weismann's theory. Brooks pointed out apropos of amphimixia that the number of ancestors of an individual does not roll up according to the formula $2^n$ (in which the power $^n$ represents the number of generations) because of constant intercrossing of relatives.

*Origin of species.*—A trend towards facts is clearly discernable in the work of the year on this subject. Natural selection was tested by the statistical method (Weldon). Galton called for facts concerning sports and their pedigree, a call which should not be unheeded by American naturalists. One such case, excellently traced, was given in 1895 by Tracy in the AMERICAN NATURALIST. Aerial discussions still went on, however. Wallace still thought that specific differences arise by the summation of slight variations, and Henslow still maintained the view that they arise from considerable self-adaptive changes.

*Mental functions.*—The differentiation of comparative physiological psychology from "metaphysics" made good progress during 1895. Lloyd Morgan did much to give to instinct a satisfactory biological definition. Among special works on the senses of animals may be mentioned the Peckhams' observations, showing that spiders recognize each other by sight, and Riley's experiments with moths, in which a marked male found a female a mile and a half away. Hodge and Aikins gave the records of the activities of a single Vorticella observed during several consecutive hours.

Studies in the ontogenesis of mental functions were made by Mills on the dog, and he and Lui agreed that there is a close parallel between the appearance of certain functions and the visible development of corresponding cortical centres. Baldwin had followed carefully the mental development of a child and laid great stress upon the rôle of imitation in the process. The development of memory, especially visual memory, and the formation of abstract concepts were also studied.

*General theories.*—This year was productive of no new guiding theories. It was still reasserted that it is vain to seek

further than for a teleological explanation of biological phenomena. Weismannism was much attacked and much mended. Cope issued several articles foreshadowing his now well-known book. Whitman showed from the history of the discussion, epigenesis *vs.* evolution, how the grounds of debate have completely changed.

In glancing over the work of the year, we see that the great advances were made in cytology in the broad sense, in the interpretation of the causes of the early ontogenetic changes, in the general physiology of organisms, in the experimental determination of form and in the quantitative study of variation. All of these are subjects little considered a decade or two ago. It is noticeable also that, although general biology has long been regarded as a free field for all speculators, the greatest activity among workers and the richest results are found when the students of fact are busy. This is the most hopeful sign for the future.

## THE SWAMPS OF OSWEGO COUNTY, N. Y., AND THEIR FLORA.

By W. W. Rowlee,
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(*Concluded from page 699.*)

### THE LAKES.

In the region of our typical swamps these lakes are frequently of considerable depth. Usually, however, they are comparatively shallow. Stories are told here, as elsewhere, of "bottomless lakes" where a line, no matter how long, would not reach the bottom. The fine mud in the bottom was, in all probability, the cause of the deception. At the bottom of the lake the mud is as mobile as water, and it is difficult to determine where fluid ends and solid begins, and hence the difficulty in sounding. There are at least three lakes in this region called Mud Lake, a fact which testifies to their character. One is Mud Lake in Oswego town already described, another is in Scriba in the same county two or three miles south of the

Lily Marsh, and the third is near Baldwinsville in Onondaga County.

The mud of the swamps gives a decided character to the streams of the region. Whether a stream rises in the lake or flows through it or any other part of the swamp, the water is colored by the mud a dark yellow or wine color. This color of the water of many of the streams led to the application of appropriate names, such as Wine Creek, Mud Creek and Black Creek.

### THE LAKE FLORA.

While the flora of the lakes present many interesting features, the plants are much less unique than those of the surrounding moor. Aquatic plants have long been noted for their wide distribution. Darwin has pointed out that this depends upon the distribution of their seed by birds. While we are ready to accept this as one of the means by which the plants disseminate themselves, we must also assert that the ultimate causes of this is the similarity of conditions presented by aquatic conditions generally. The conditions are very much the same in our lakes as in other similar bodies of water, such as slow flowing streams and lakes with hard shores. Aquatic floras are, however, quite distinct from terrestrial ones of the same region. The moors surrounding our lake come very near affording aquatic conditions. Nevertheless the shore line between lake and moor is a pretty definite one. The following are species representative of the lake flora:

The *Naiadaceæ* afford a characteristic group belonging here. None of them find congenial conditions outside the bounds of the lake, and most of them are confined to water several feet deep. *Potamogeton amplifolius, P. lonchites and P. heterophyllus* are in the latter class, while *Naias flexilis* and *P. foliosus* approach nearer the shores.

*Vallisneria spiralis* is a plant which does not appear very near the shores.

*Eleocharis mutata* must be considered, at least in this region, a lake plant, as at Lake Neahtahwantah and Paddy Lake, our only stations for it, it grows only in water. It seems essential, however, that its roots only should be submerged; the culms

always appear above water, and consequently it occurs only upon rather shallow shores.

The Lemnaceæ are represented in the lakes by *Lemna trisulca*, *L. minor* and *Spirodela polyrhiza*, none of which make any attempt to grow in the bog.

*Eriocaulon septangulare* is one of the few plants that are common to the lake and the moor, in fact, it is about the only one. Whether it grows upon sand in a few inches of water, or upon the soft mud in the newest portions of the moor, it seems equally at home. I have found it growing in four lakes in the county, but never saw it in a swamp where there was no lake. Paine says (Cat. of Plants of Oneida Co.), of the distribution of this plant, "Lakes and ponds of the north woods, throughout and common." I conclude, therefore, that the plant is, in this region, a lake plant.

*Heteranthera dubia* is a deep water plant, and grows in these lakes as well as in slow flowing streams.

The whole order Nymphæaceæ is a water-loving group. With rare exceptions it is confined to the shallower portions of the lake. The exceptions are cases where the strong rootstock of *Nymphæa* and *Castalia* have persisted after the moor has advanced into the lake beyond them and sends up, for a few years, its leaves and flowers through the thin turf. The contrast between the black mud of the moor and the pure white flowers of *Castalia* is very striking. *Brasenia purpurea*, *Castalia odorata*, *Nymphæa advena* are the representative plants. The depth of water in which these plants grow ranges from one to six feet, only rarely going outside these limits.

*Myriophyllum spicatum* is a well-known aquatic finding a place here.

The Lentibulariaceæ is represented by two species in the lakes and several others in the moor. None of its species are common to both lake and moor. *Utricularia vulgaris* and *U. minor* are the lake plants. While occurring in other places, they thrive particularly well in the muddy lakes surrounded by moors.

And, finally, for the order Compositæ, we have, in our lakes, a single representative in *Bidens beckii*.

THE FLORA OF THE MOOR.

There is no group of plants more interesting from the point of view of their geographical distribution than the one which constitutes the moor flora. Allusion has already been made to the probable post-glacial history of the flora; and attention has also been called to its relation to the Alpine flora of New York State. The general fact that the two floras approach each other toward the north until we find them closely associated in Arctic regions, is pretty conclusive evidence of closer association in post-glacial times. But their limited distribution and their relation to our Alpine flora is no more interesting than their distribution in the moor itself. Some of the plants are restricted to the newer portions of the bog; others are only found in the older portions. Those of the newer portion are, in general, the invading plants; those of the older portion sometimes persist in the wooded belt. In the older portions of the bogs there sometimes appear upland plants. A general survey of the species may here be made.

The *Juncaginaceæ* are all marsh plants. In our region they are, so far as I know, mainly confined to the newer portion of the sphagnous moors. *Triglochin maritima* occurs at Mud Lake, Oswego town, " Paradise," So. Mexico, Granny's Orchard, Palermo, and other places. According to the Manual (Gray's) it occurs at the seashore and in saline places across the Continent. Mud Lake is by no means a saline place. *T. palustris* has not been seen, so far as I know, in Oswego County, but occurs at Junius, Seneca County, in the same basin, also upon the " boggy borders of Onondaga Lake; at Salina, and northward beyond Liverpool" (Paine, l. c., p. 81). *Scheuchzeria* occurs in the newer portions of all our sphagnous moors.

There are but few *grasses: Phragmites, Muhlenbergia racemosa, Panicularia canadensis* and *Calamagrostis canadensis* are frequently found in the moors, but are not confined to them.

On the other hand the *Cyperaceæ* is one of the best represented orders. Here, and here almost exclusively, the species of woolgrass (Eriophorum) grow. One of the most effective bog-making plants in this region is *Carex filiformis,* the rootstocks of which form a very strong warp into which other

plants are woven. It presses up close to the margin of the lake, and affords a pretty sure indication as to whether it is safe to venture upon the place or not. Other characteristic carices are *C. pauciflora, C. teretiuscula, C. magellanica, C. limosa, C. exilis* and *C. redowskyana.* Other species of Carex, as well as some species belonging to other genera in this order, are often found in the bog.

*Peltandra virginica* is in the moors, but occurs as well along all our streams. Calla, while perhaps not exclusively a moor plant, occurs here more frequently than anywhere else.

But a single species of the *Liliaceæ* is found, viz.: *Vagnera trifolia.*

In distinct contrast we find this the chosen home of our rarest orchids. The representative species are: *Habenaria blephariglottis, H. clavellata, H. dilatata, H. leucophæa, Cypripedium reginæ, Pogonia ophioglossoides, P. verticillata, Arethusa bulbosa, Gyrostaichy romanzoffiana, Listera australis* and *Limodorum tuberosum.*

Two willows, *Salix myrtilloides* and *S. candida*, are exclusively moor plants in this region.

*Sarracenia purpurea* is confined to the moors, and is one of the most unique in appearance and habits of moor plants.

*Drosera intermedia* occurs only in the newest portions of the moor, while *U. rotundifolia* is more often in the drier portions, sometimes even growing upon rotten logs at the margin.

Three of the *Rosaceæ* are conspicuous moor plants. *Comarum palustre* is usually upon the water's edge, and is a pretty effective moor builder. The other species are *Geum rivale* and *Sanguisorba canadensis*, both of which are in the more mature portions.

*Decodon verticillatus* occurs in considerable abundance in most of the lake-containing swamps, but, as is well-known, is not confined to them. It is also an important moor builder.

Two species of Epilobium are confined to the moors—*E. lineare* and *E. strictum.*

*Proserpinaca palustris* must also be included here.

The *Ericaceæ* is one of the three most conspicuous orders in the moors. The other two are the sedges and the orchids.

The species here which are exclusively moor plants are : *Ledum Groenlandicum*, *Kalmia glauca*, *Andromeda polifolia*, *Chamædaphne calyculata*, *Chiogenes hispidula*, *Schollera oxycoccus* and *S. macrocarpa*. Many others, especially species of Vaccinium, live in the moor, but are not confined to them.

*Menyanthes trifoliata* is a moor plant, and is not uncommon in our region.

The *Lentibuliariaceæ* contribute to this group *Utricularia cornuta*, *U. gibba*, *U. intermedia* and *U. resupinata*, all of which are rare plants and grow only in the newer portions.

In the order *Compositæ*, but three species can lay claim to being exclusively moor plants. These are *Solidago ohioensis*, *S. uliginosa* and *Aster junceus*.

## THE FLORA OF THE WOODED BELT.

The third zone of the whole swamp is still to be considered. To attempt to enumerate the species as has been done in the case of the bog and the lake would contribute little to our picture of the swamp as a whole. The species are, for the most part, the same as may be found upon the surrounding uplands, especially in low places. In fact, we may say that just as the moor is steadily invading the lake, so the wooded belt is invading the moor, and there is by no means the sharp limitation to the outer edge of the wooded belt that there is to the outer edge of the moor or of the lake. It is always a tree-covered tract in the natural state, the size of the trees increasing as one passes from the edge of the moor to the hard shore. The trees which appear most frequently are *Ulmus americana*, *Acer saccharinum*, *Fraxinus nigra*, *Pinus strobus*, *Thuya occidentalis*, *Larix laricina*, *Picea mariana* and *Betula lenta*. Of these the predominating species are the first three or four. Shrubs are more abundant in the more open portions near the moor. *Lindera Benzoin*, *Ilex verticillata*, *Ilicioides mucronata* and several species of *Vaccinium* are the most prominent. The herbaceous the wooded belt is not a very rich one. Caltha often covers flora of the ground. The most prominent plants are the Osmundas, which grow in rank profusion. *Smilax hispidia*, *Arisæma triphyllum*, *Dalibarda repens*, *Trientalis americana*, *Medeola vir-*

*giniana* and many others also grow here. As might be expected, it is a flora made up of species which are by no means confined to this particular place. Some of them flourish equally well upon the surrounding uplands; a few grow in the open moor; many grow in low grounds that do not have the vegetable accumulations characteristic of these swamps.

### THE DISAPPEARANCE OF SPECIES WITH THE MATURING OF THE BOG.

The rareness of some of the bog plants attest the gradual disappearance of species from these places. Specimens of *Listera australis* were found by Father Wibbe at the Lily Marsh in New Haven in 1877, where he reported it as growing abundantly.[2] The writer has visited the same place several times since 1888, and has failed to find it again. It is safe to say that it is not abundant there now. A few plants were found by the writer in "Granny's Orchard," in Palermo, in 1895. Here continued and careful search resulted in the finding of but a few plants. Dr. W. M. Beauchamp has found the same species growing at Mud Lake near Baldwinsville, Onondaga County. Here, too, only a few specimens were found. These are, so far as known, the only stations for this species north of New Jersey. It is significant that a considerable number of species, not only those that affect bogs, but some Upland ones, have the same general range as *Listera australis.* The most conspicuous of these are: *Rhexia virginica, Nyssa aquatica, Eriocaulon septangulare, Triglochin maritima, Xyris montana, Scheuchzeria palustris* and several of the *Utricularias.* It seems a reasonable inference that formerly there existed in these regions conditions much more congenial to these plants; that then they were more abundant and continuous in their range than now, and that they have settled in the limited tracts which afford them a congenial home. The conditions which conduce to their persistency are no doubt complex. The main ones, however, seem to be a constant and abundant humidity in the air and abundant moisture in the soil, and, at the same time, a relatively even temperature throughout the year. Humidity

[2] Bull. Torr. Bot. Club, VI, 192.

in the air is maintained by the extensive surface of the sphagnous moss from which it steadily evaporates great quantities of water. Many plants, especially the delicate orchids, are found only in the moss. The humidity of the air immediately at the surface of the moss at once suggests the conditions in the tropics where the epiphytic orchids thrive.

COMMERCIAL VALUE OF THE BOGS.

The capacity of the moss to hold moisture and the evenness and freedom with which it gives it up, has led to its extenstve use in packing the roots of plants during shipment. In the Lily Marsh and Mud Lake in Oswego township, the moss has been removed from a large part of the moors. The effect upon the bog itself is anything but wholesome. By this treatment a clean, mossy moor is turned into a stinking, sour, unsightly and treacherous mud-hole. Nowhere did I ever see such violence done to nature as where the moss is removed from a moor. The traditional woodman's axe does not compare; a burnt forest soon recovers itself to a certain extent; but a bog from which the moss has been taken reclothes itself very slowly, and will probably never become a thick turf as originally. Certainly none of the rarer plants will endure such treatment.

CONCLUSIONS.

1. Swamps form one of the striking and important topographical features of Oswego County.

2. These may consist of a lake, a moor and a wooded belt but in many the lake has been converted into a moor, and in others both lake and moor have passed over into wooded tracts.

3. The surface of the county was fluted by the ice; this determines the outline of all the swamps.

4. The finely pulverized remains of plants (mud) are stirred up with every wind, so that material is constantly shifted from the muddy shores to deeper water.

5. The agitation of the water by the wind has two important influences on the shore: its violence prevents sphagnum from growing at the water's edge; Cassandra, sedges and Decodon, with others, form a barrier at the edge; second, it pre-

vents plants from gaining a foot-hold on the eastern shores where the lakes are of considerable size.

6. The flora of the moor has among its species some of the rarest plants of the region.

7. A considerable number of species otherwise confined to the Atlantic coast occur here. It does not follow, as Paine asserts (l. c., p. 92), that a maritime bay occupied this depression.

8. The distribution of moor-loving plants suggests that once conditions of humidity and temperature enabled them to grow very much more abundantly than now.

9. The commercial value of the moss bids fair to devastate the moors, and their recovery will, of necessity, be very slow.

## EDITOR'S TABLE.

With the present number the AMERICAN NATURALIST comes into the possession of new proprietors and under the charge of new editors. We do not propose to make promises of improvement; but shall leave the journal to speak for itself upon that score. We do think it due to our readers, however, to state our convictions as to the position the NATURALIST should occupy in the future.

As we see it, there are, under existing conditions in science, only three kinds of scientific serials that can hope to prosper. There is, on the one extreme, the technical journal devoted to a single strictly defined subject and intended as a repertory of the results of research. At the other extreme is the popular scientific journal which seeks to interest and instruct those who are without specific scientific training. Lastly, between these extremes, comes the general scientific journal which holds a distinct position; it is intended for the students and workers in science—a constituency which has already attained considerable size in this country and is rapidly growing. The NATURALIST aims at being such a journal with such a constituency.

The objection may be made, however, that this constituency is an ill defined one and is without common needs. There are two answers to this objection; the *á priori* answer and that of experience. The *á priori* answer is that, despite the fact that science is becoming more differentiated, its separate disciplines are expanding and coming to

overlap. Especially is this true of the natural sciences. The fusion of the biological sciences is wellnigh complete; and they, in turn, grade into geology through geographical distribution and physical geography on the one hand, and through palæontology on the other. All of the natural sciences, moreover, must seek for their bases within the realms of chemistry and physics. Indeed in the development of the new fields of biological geology, chemical geology, bio-chemistry, and bio-physics we can foresee the clearer and more general recognition of the solidarity of the sciences.

The answer of experience is not less decisive. No one can doubt that journals of that class in which *Nature, Science, La revue scientifique,* and *Naturwissenschaftliche Rundschau* are notable examples, meet a perfectly well defined need, and their prosperity gives us hope for success. We accept the answers *á priori* and *á posteriori* and fear no lack of a constituency.

One other point. Every scientific man, as such, may well read two general scientific journals, the weekly scientific newspaper and the monthly review of scientific progress. We recognize that the first of these is already admirably supplied in this country; we believe that THE AMERICAN NATURALIST should furnish the second.

Certain matters of detail are determined by the proposed position of the NATURALIST. We cannot publish very technical works but shall welcome such results of research upon the broader problems of the sciences as may be expected to interest a large share of our readers. For example, it would be inconsistent with our plan to publish a minute description of some anatomical feature or a mere list of the species found in some region; unless, in the first case, the subject should appear to have broad morphological or physiological bearings, or, in the second case, owing to the interesting character of the types or some peculiarity of their distribution, the list should be shown to have exceptional value. On the other hand, papers intended for beginners, such as, "Some birds of the garden," "Some common weeds," are not appropriate for this journal. What we desire is scientific papers written by scientific persons and of interest to scientific workers in more than one field. In addition to results of research, we shall look for summaries of progress in natural science, discussion of scientific questions of the day, and reviews of books and the more important papers. Remembering our title, while not forgetting that science is cosmoplitan, we shall seek especially the advancement of natural science in America.

Such, then, is our programme. To carry it out we invite the coöperation of every American naturalist.

It was a very natural thing that Delage, after going over the ground that he did in the preparation of his great work on "Les grands problèmes de la biologie générale" should see the need of frequently gathering together and classifying the widely scattered data belonging to this field; and thus came into existence the new annual, *L'Année Biologique*, whose first number lies before us.

Its scope is very broad. There are twenty general subjects treated in twenty chapters. These subjects are: 1, the cell; 2, the sexual products and fecondation; 3, parthenogenesis; 4, asexual reproduction; 5, ontogenesis; 6, teratogenesis; 7, regeneration; 8, grafting; 9, sex and secondary sexual characters; 10, polymorphism, metamorphosis, and alternation of generations; 11, latent characters; 12, correlation; 13, death, immortality, and the germ-plasm; 14, general morphology and physiology; 15, heredity; 16, variation; 17, the origin of species, phylogeny; 18, the geographic distribution of species; 19, mental functions; 20, general theories–generalities.

The organization of the journal is as follows: Professor Delage is the director of the serial, Dr. Georges Poirault is secretary of the "Redaction," and there is a committee of fifty-three compilers who review papers. This committee is an international one, consisting of forty-four Frenchmen, three Belgians, three Englishmen, one Russian, one Swiss, and one American. In addition to reviews of individual papers, some of these compilers have furnished summaries of progress in a subject. With the reviews of any chapter in their hands, the director and secretary have made a summary, exhibiting in a few pages the salient points of progress made during the year in the subject under consideration. This summary precedes the reviews in each chapter, so that the reader may first quickly read the accounts of progress in the different subjects and then look up the more detailed reviews of any particular papers. Finally, there is a "Table analytique" in which are references to about 2500 subjects, groups, and authors; e. g., Heliotropisme, Helix, Helmholtz. Altogether much good judgment has been exercised in the arrangement of the contents of the annual and in making cross references so that the work shall be most serviceable to the student.

As for the reviews themselves, they are in general *reviews* and not *abstracts*, in which respect they quite throw in the shade the contents of the usual "Berichte." Most of them are, of course, less than a page long but important works command much more space. Thus the review of Roux's "Gesammelte Abhandlungen" occupies 13 pages; of Tornier's "Entstehung der Gelenkformen" 7½ pages: of Verworn's

"Allgemeine Physiologie" 10 pages; of Lloyd Morgan's "Definitions of Instinct" 7½ pages (complete translation); of Baldwin's "Mental Development" 8 pages; of Coutagne's "Polymorphisme des Mollusques" (by the author) 6 pages. Many of the reviews are accompanied by valuable critical comments and some of them are illustrated by simple figures.

The summaries of progress and comprehensive reviews are very valuable. Some of these are: Influence of stock on graft, by Daniel; Experimental data upon functional correlation in animals, by Gley; On polyzoism and on the integrating organologic unity in Vertebrates, by Durrand; The defences of the organism in the presence of virus (33 pages), by Charrin; The soluable ferments, by Bourquelot; Comparative study of microbic toxines and of venin, by Phisalix; The modern conception of the structure of the nervous system (25 pages, 7 figures) by Mlle. Szczawinska; Modern psychology and its recent progress (28 pages), by Binet; Note on the theory of plasomes, by Wiesner, with response by Delage; On the phenomena of reproduction, by Hartog. These summaries touch a large proportion of the biological subjects whose advance characterized the year 1895.

Without going at all into the subject matter of this number, which will be considered elsewhere, this much may be said: The appearance of *L'Année biologique* with its classification, analysis, and synthesis of a vast array of facts, many of which find elsewhere no reception, is doing an important work in bringing general biology into recognition as a science coördinate with, although overlapping, morphology and physiology.

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There is an important omission, it seems to us, in the list of over 500 periodicals consulted by the editors of *L'Année Biologique*. This omission is of a class of journals which are on the borderline of the scientific but yet contain important biological data. To this class belong the journals devoted to agriculture, horticulture, breeding veterinary medicine, surgery and medicine. From such journals Darwin obtained many of his most important facts. We open his "Variation of Animals and Plants" at random and quote some of his references; Gardiner's Chronical, Encyclopedia of Rural Sports, Horticultural Transactions, Journal of Horticulture, Journal of the Roy. Horticult. Soc., British and Foreign Medico-Chirurg. Review, Jour. of Agricult. of Highland Soc., Landwirthschaft. Wochenblatt, Jour. del'Acad. Hort. de Gand. Interspersed with such as these there are, of course, references to the more scientific journals. There is no question, however,

but that now, as in Darwin's time, many most valuable data are to be gleaned from such serials as are enumerated above. It would be well if the new annual could undertake this work also.

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We welcome the news that America is at last to have a representative Journal of Physiology; and it is especially gratifying that it is to embrace all fields of physiology, including bio-chemistry, physiological morphology and the physiology of invertebrates. The Journal will be edited by a representative Committee of the American Physiological Society, and will be under the immediate charge of Dr. W. T. Porter of the Harvard Medical School. The price has been set at five dollars per volume of about five hundred pages. The editors modestly suggest that not more than one volume a year will be necessary; we, however, confidently expect that in a few years the American Journal of Physiology will be rolling up as many volumes a year as Pflüger's Archiv does. To enable it to do this, however, it will need the subscriptions of all who are interested in its success. The subscriptions may be sent to Dr. Porter.

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Prof. Baur's Observations on the Origin of the Galapagos Islands, begun in the August number, will continue in October.

## RECENT LITERATURE.

**Tarr's Elementary Geology.**[1]—A small octavo volume intended by the author as a text-book for use in secondary schools. The main facts of structural and dynamic geology are given in a graphic, concise way that will best impress a young student. Stratigraphic geology is somewhat curtailed in treatment in accordance with the author's views as to the need of the average high school student. We notice in the time-scale that Pleistocene is adopted instead of the older Quaternary and Eocene and Neocene used in place of Tertiary.

The illustrations are numerous, many of them being original. They comprise 25 page plates and 485 reproductions from photographs and diagrams in the text.

Mr. Tarr is to be congratulated upon having chosen judiciously from a mass of material the facts necessary to a good foundation for further study of the history of the earth.

**U. S. Commission of Fish and Fisheries.**[2]—The report of

[1] Elementary Geology. By R. S. Tarr. New York, 1897. 8vo, MacMillan & Co., $1.40.

[2] U. S. Commission of Fish and Fisheries. Pt. XXI. Report of the Commissioner for the year ending June 30, 1895. Washington, 1896.

the Commissioner for the year ending June, 1895, comprises reports on the propagation and distribution of food fishes, by W. C. DeRavenal; on food fishes and fishing grounds, by Richard Rathbun; and on the statistics and methods of the fisheries, by H. M. Smith. In addition there are several papers based on the work of the Commission. These comprise the investigations of the steamer Albatross by Lieut. Com. F. J. Drake; Biscayne Bay as a Marine Hatching and Experiment Station, by H. M. Smith; Transplanting of Eastern Oysters to Willapa Bay, Washington, by C. H. Townsend; Description of a New Shad from Alabama, by B. W. Evermann; and a Check-List of the Fishes and Fossil-like Vertebrates of North and Middle America, by D. S. Jordan and B. W. Evermann.

These various papers demonstrate the importance of the work carried on by the Commission, both from an economic and scientific standpoint. From year to year this organization accumulates and records an immense amount of information that stands for all time as reliable data.

**Hand-book of British Birds.**[3]—This book comprises an enumeration of every species of birds on the British list, with descriptions of nearly all the species named. Records of the rarer forms have been carefully collected, and a tolerably complete life-history of the common species is given. In the nomenclature the author adopts the American system of trinominals, as he sees no other way of allowing a name to a recognized race without giving it the rank of a species. In all, Mr. Swann recognizes 381 species which are referred to 208 genera. The volume constitutes a handy reference book for the student afield.

**A List of Periodicals.**—Nearly twenty years ago a small pamphlet was published containing a list of scientific periodicals, transactions of learned societies, etc. accessible in the libraries in the vicinity of Boston. The list became antiquated and has long been out of print. In the present year the Boston Public Library has taken up the same idea and the result is a list of periodicals, etc.,[4] which must be of the greatest value to students in any line as it is a catalogue of the largest collection of serial publications accessible in any locality in America. Unlike its modest predecessor, it is not limited to science but embraces the periodicals of all kinds contained in thirty-six libraries in Boston,

[3] A Concise Handbook of British Birds. By H. Kirke Swann. London, 1896.

[4] A list of periodicals, newspapers, transactions, and other serial publications currently received in the principal libraries of Boston and vicinity. Boston: The Trustees of the Public Library, 1897, pp. 143.

Cambridge, Somerville and Jamaica Plain. The titles are given and with each title are index letters indicating in which library the periodical may be found. Numerous cross references add to the value of the list, which, while intended for students in the neighborhood of Boston, will prove of great value to investigators in any locality.

In this connection we might call attention to the fact that the Boston Society of Natural History published,[5] a few years ago a list ot serial publications currently received in its library and that it has now issued a supplement to this list as well as a list of discontinued serial publications in its library[6] of about four hundred titles.

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# General Notes.

## PETROGRAPHY.[1]

**Igneous Rocks of Trans-Pecos, Texas.**—The igneous rocks intrusive in the sedimentary series of Trans-Pecos, Texas, according to Osaun[2] comprise plutonic, dyke and effusive types belonging to a series of rocks rich in soda. They are characterized by the possession of alkaline pyroxenes and amphiboles (aegirine, aegirine-augite and arfvedsonite), of microperthitic intergrowths of orthoclase and albite, and of riebeckite, lavenite and a mineral resembling ainigmatite. In the Apache Mountains the plutonic rocks are accompanied by dykes of paisanite, tinguaite and bostonite. The intrusive phases of this series are eleolite-syenites, normal and porphyritic varieties, aegirine-syenites and normal syenites. The dyke rocks identified are tinguaite, bostonite, paisanite, (see analysis I, below), and the effusives are rhyolites and phonolites. Several of these rocks have been noticed in the reports of the Texas Geological Survey.[3] The paisanite is regarded as a quartz bearing member of the gromdite-tinguaite series as found in the neighborhood of Christiana. The Texan phonolite is of such a peculiar type that it has been designated as apachite. It occurs in two laccolites and in sheet form. The rock is composed of phenocrysts of sanidine and nepheline, the latter often surrounded by rims of amphiboloids in a

[5] Proceedings of the Boston Society of Natural History. Vol. XXVI, 1894.

[6] Proceedings, vol. XXVIII, 1897.

[1] Edited by Dr. W. S. Bayley, Colby University, Waterville, Me.

[2] Min. u. Petrog. Mitth., XV, p. 394.

[3] Cf. AMERICAN NATURALIST, 1894, p. 514.

groundmass consisting of diopside-malacolite, augite, aegirin-augite and aegirine, amphiboles, related to arvfedsonite and katoforite, ainigmatite, several generations of feldspar and a small quantity of glass. Apachite differs from normal phonolite in the great abundance of ainigmite and the members of the hornblende group, and in the younger age of the latter with respect to the pyroxene. It contains also great quantities of microperthitic feldspars.

An analysis of the rhyolite of Fort Davis is given under II.

| | $SiO_2$ | $Al_2O_3$ | $Fe_2O_3$ | FeO | MgO | CaO | $Na_2O$ | $K_2O$ | $H_2O$ | $TiO_2$ | $P_2O_5$ | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| I. | 73.35 | 14.38 | 1.96 | .34 | .09 | .26 | 4.33 | 5.66 | | | | = 100.37 |
| II. | 71.10 | 11 39 | 5.33 | | 1.54 | .08 | 3.95 | 6.37 | .44 | .57 | .05 | = 100.82 |

**Italian Petrographical Studies.**—In a recent paper, Washington[4] summarizes the results of his work on the Bolsena-Vesuvius volcanics, and presents some views on the classification of leucite rocks and of those intermediate in composition between trachytes and basalts. In accordance with the nature of their feldspathic constituent, he would divide trachyte-basalts into a trachyte series, embracing those rocks containing only an alkali-feldspar, a trachy-andesite series, including those containing an alkali-feldspar and an acid plagioclase, a trachy-dolerite series, composed largely of an alkali feldspar and a basic plagioclase, an andesite series—acid plagioclase (andesine-oligoclase) rock, and a basalt series, a basic plagioclase series. Among the trachy-andesites the author would place the Iceland rhyolites, vulcanite, dornite, the Euganean and the basic auvergne trachytes, and among the trachy-dolerite series the toscanites, the vulsinites and the ciminites described by himself, and the banakites, shoshonites and absarokites of the western United States. The leucite rocks met with in the Italian volcanoes are thought to be best classified as leucitites, leucite-basalts, leucite-basanites, leucite-tephrites, leucite-trachytes and leucite-phonolites. Upon comparing their analyses the silica contents of these rocks are discovered to cluster around 49 per cent and 56 per cent, a fact which is regarded as not due to accident. The original magma, of which the Italian volcanoes are the differentiated products, is thought to have had a composition approximating the following: $SiO_2$=57–58; $Al_2O_3$=17–18; FeO ($Fe_2O_3$)=6–7; MgO=2–3; CaO =5–6.5; $Na_2O$=2.25; $K_2O$=7–8; $H_2O$=1–1.5 per cent.

**Rock Differentiation.**—Iddings[5] devotes a few pages to his theory of rock differentiation as applied to the Electric Peak volcanics, reply-

[4] Jour. of Geology, Vol. V, p. 349.

[5] Quart. Jour. Geol. Soc., Vol. LII, 1896, p. 606.

ing to criticisms recently made by Brögger. This author declares that the order of primary differentiation can be learned only from a study of large bodies of plutonic rocks, and that conclusions with respect to this subject based on the study of extensive masses are not reliable. He further states that the order of succession in eruptions is from basic to acid magmas, often ending with basic ones, and not from intermediate magmas to greater and greater extremes. After describing at some length the general distribution of the igneous rocks in Idaho, Montana and Wyoming, and comparing the great volume of the effusive rocks erupted in this volcanic district with the relatively small (though actually great) volume of intrusive rocks, Iddings states that he cannot but believe that the differentiation which gave rise to the former must have been more fundamental than that which gave rise to the intrusive rocks, and hence its products reveal the true character of the primary differentiated of a molten magma at considerable depths beneath the surface. Moreover, the sequence of the intrusive rocks is practically the same as that of the effusive in the Electric Peak district, viz., from intermediate through acid to basic rocks.

**Granites of Pyramid Peak District, California.**—Lindgrew[6] describes the rocks of the Pyramid Peak district in the Sierra Nevadas as consisting of an older series of slates, tuffs, schists, porphyrites and granitic rocks overlain by Tertiary andesites, rhyolites and basalts. The granites are intrusive in the old series, metamorphosing the latter for a distance of several miles from their contacts with them. The clay slates in their most metamorphosed forms are micaceous schists or gneisses. At a greater distance from the granite they are 'knoten schiefer,' often carrying andalusite. The granitic rocks include aplites, granites, granite-diorites, diorites and gabbro. The highest ridges of the district are composed of granitite. Granodiorite is the predominant rock. It consists of quartz, an acid plagioclase, biotite, hornblende and a little sphene and magnetite. The rock is intermediate in composition between quartz-mica-diorite and Brögger's quartz-monzonite. While not always easily distinguished from the former rock, the author would restrict the name granodiorite to rocks containing 59 per cent.–69 per cent. $SiO_2$, 14 per cent.–17 per cent. $Al_2O_3$, 1½ per cent.–2¼ per cent. $Fe_2O_3$, 1½ per cent.–4¼ per cent. FeO, 3 per cent.–6½ per cent. CaO, 1 per cent.–2½ per cent. MgO, 1 per cent.–3¾ per cent. $K_2O$ and 2½ per cent.–4½ per cent. $Na_2O$. Analyses of the granite (I) and of the grano-diorite (II) follow :

[6] Amer. Jour. Sci., Vol. III, 1897, p. 301.

| | $SiO_2$ | $TiO_2$ | $Al_2O_3$ | $Fe_2O_3$ | $FeO$ | $CaO$ | $MgO$ | $K_2O$ | $Na_2O$ | $H_2O$ at 100% | $H_2O$ at 100% | $+P_2O_5$ | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| I. | 77.68 | .14 | 11.81 | .72 | .51 | .72 | .18 | 5.00 | 2.96 | .04 | .27 | .10 | =100.13 |
| II. | 67.45 | .58 | 15.51 | 1.76 | 2.21 | 3.60 | 1.10 | 3.66 | 3.47 | .14 | .63 | .12 | =100.25 |

**Pegmatite.**—As the conclusion of a very thorough discussion of the origin of pegmatite Crosby[7] and Fuller declare that this rock is the product of crystallization from an igneous magma saturated with water —an igneo-aqueous solution. The authors, moreover, believe that no sharp line of distinction can be drawn between dykes and veins and, therefore, that veins are clearly entitled to some degree of recognition in the lithological classification.

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## BOTANY.[8]

**Gray's Synoptical Flora.**[9]—On the tenth of June, just twenty months after Fascicle I, Dr. Robinson brought out Fascicle II of the new edition of Gray's Synoptical Flora of North America. It includes the "orders" Caryophyllaceæ (by B. L. Robinson), Ficoideæ (by B. L. Robinson), Portulacaceæ, Tamariscineæ (by B. L. Robinson), Elatinaceæ, Hypericaceæ (by J. M. Coulter), Ternstroemiaceæ, Cheiranthodendreæ, Malvaceæ, Sterculiaceæ, Tiliaceæ, Linaceæ (by W. Trelease), Malpighiaceæ, Zygophyllaceæ, Geraniaceæ (by W. Trelease), Rutaceæ, Simarubaceæ, Burseraceæ, Anacardiaceæ, Meliaceæ, Aquifoliaceæ (by W. Trelease), Cyrillaceæ, Olacinaceæ, Celastraceæ (by W. Trelease), Rhamnaceæ (by W. Trelease), Vitaceæ (by L. H. Bailey), Sapindaceæ (by B. L. Robinson), and Polygalaceæ (by B. L. Robinson). It is thus seen that of these twenty-eight families, twelve were prepared by other hands than Dr. Gray's, and in several of the remaining sixteen more or less extensive revisions were made by Dr. Robinson.

We note with interest the much freer acceptance of disputed names than in the previous fascicle; thus we have *Impatiens aurea* Mahl. and *I. biflora* Walt. (instead of *I. pallida* Nutt. and *I. falva* Nutt.); *Vitis vulpina* L. (instead of *V. riparia* Mx.); *Vitis rotundifolia* Mx. (instead of *V. vulpina* of American authors); *Acer saccharinum* L. (instead of *A. dasycarpum* Ehrh.); *Acer saccharum* Marsh (instead of *A. sacchari-*

[7] Technology Quarterly, IX, 1896, p. 326.

[8] Edited by Prof. C. E. Bessey, University of Nebraska, Lincoln, Nebraska.

[9] *Synoptical Flora of North America*, Vol. I, Pt. I, Fascicle II. Polypetalæ from the Caryophyllaceæ to the Polygalaceæ, by Asa Gray M. D., continued and edited by Benjamin Lincoln Robinson, Ph. D., pp. 207 to 506. Issued June 10, 1897. New York, American Book Company.

*num* Wang.); and *Acer negundo* L. (instead of *Negundo aceroides* Moench.). A title page and an excellent index to Fascicles I and II, which are to be bound together, close this interesting part. The third Fascicle is now in preparation by Dr. Robinson.

—CHARLES E. BESSEY.

**Britton and Brown's Illustrated Flora.**[10]—Last August the first copies of Vol. I of this work were distributed, and about the middle of June of the present year copies of Vol. II reached the botanists of the country. The good opinion of the work formed from an examination of the first volume is confirmed by even a glance through the second. The outline figures continue to be most useful, and while not always absolutely distinctive, they are often fully as much so as the actual specimens. We have now and then seen criticisms of these figures by those who forget that it is impossible to show striking differences between species which nature has not separated widely, especially when the figures must be made as small as they are in this work. We feel that the artists who made these illustrations are deserving of much praise for the success with which they have done their work.

As to the text there remains little to be said beyond what was said in our notice of Vol. I (NATURALIST, October, 1896). The selection of type is so good that the eye catches without loss of time the items sought. The consistent use of the modern rules of nomenclature, readily familiarizes us with the comparatively small number of new names made many by the " reform movement."

The families of most interest in this volume are Ranunculaceæ, Crucifereæ, Saxifragaceæ, Rosaceæ, Pomaceæ, Drupaceæ, Mimosaceæ, Cæsalpiniaceæ, Papilionaceæ, Euphorbiaceæ, Violaceæ, Cactaceæ, Onagraceæ, Umbelliferæ, Ericaceæ, Vacciniaceæ, Oleaceae and Gentianaceæ.

We notice that a list of metric units and equivalents is given at the end of the table of contents. Of what service it can be in a volume in which no metric measurements are used is difficult to make out. It only serves to call attention to the anachronism of ancient units in a modern text. The concluding volume will be looked for with great interest by botanists everywhere.—CHARLES E. BESSEY.

[10] *An Illustrated Flora of the Northern United States, Canada and the British Possessions*, by Nathaniel Lord Britton, Ph. D., and Hon. Addison Brown. In three volumes. Vol. II, Portulacaceæ to Menyanthaceæ. New York, Charles Scribner's Sons, 1897.

## ZOOLOGY.

**Fauna of Aldabra.**—The following information concerning the natural history of the island of Aldabra has been recently published by Dr. W. L. Abbott. The most remarkable inhabitant of Aldabra is the gigantic land tortoise, similar to those of the Galapagos group. They were formerly very abundant, but being easily caught and in great demand for their flesh, their numbers have been greatly diminished by the whalers and fisherman. Their greatest enemy is the common rat, which swarms upon Aldabra and eats the young as soon as they are hatched.

The only other land reptiles upon Aldabra are a small lizard (*Ablepharus poecilopleurus*) and two geckos (*Hemidactylus mabronia* and *Phelsuma abbottii*).

Turtles are plentiful. Many thousands annually ascend the sandy beaches to deposit their eggs. Tortoise-shell was formerly gathered in large quantities, but this fishery has been overworked and large "carré" are now scarce.

Mammals are represented by a large fruit bat (*Pteropus aldabrensis* True) and two smaller bats. Rats (*Mùs decumanus*) probably from wrecked vessels, swarm everywhere, and are very destructive. Cats, probably from the same source, are common upod Grande Terre, where they have completely exterminated the flightless rail.

Land birds are represented by fourteen resident and six accidental visiting species.

The most interesting of birds is the curious flightless rail (*Rougetius aldabranus* Ridgway), the sole survivor of the numerous flightless birds that inhabit the Mascarine Islands at the time of their discovery. The present species is in great danger of being exterminated by the cat, which sooner or later will overrun the smaller islands, as it has done Grande Terre. The other land birds are apparently identified with those of Madagascar.

Insects are not numerous either in species or individuals. Six or seven butterflies, a few moths, a dragon fly, a few beetles, some flies and bees are found. Mosquitoes abound. (Proceeds. U. S. Natl. Mus. XVI, 1894.)

**A List of the Birds of the Vicinity of West Chester, Chester Co., Pennsylvania.**—(*Continued from page 628.*)—

72. *Ammodramus savanarrum passerinus* (Wils.), Grasshopper Spar-

row. Rather infrequent summer resident, during some years not seen at all.

73. *Zonotrichia leucophrys* (Forst.), White-crowned Sparrow. Very infrequent, if not rare, migrant in the spring and fall. I shot a bird of the year on Oct. 18, 1890, and another Oct. 6, 1888; and during one spring I saw an adult male.

74. *Z. albicollis* (Gmel.), White-throated Sparrow. Abundant migrant in the spring and fall, but it does not appear to remain through the winter. (Dates of spring occurrences: April 25, 1886; April 28 to May 10, 1887; May 9-19, 1888; March 29, 1889; April 12, 1890; April 18, 1891. Latest fall occurrences: Nov. 6, 1886; Oct. 27, 1887; Dec. 31, 1888; Nov. 1, 1890).

75. *Spizella monticola* (Gmel.), Tree Sparrow. Abundant winter resident. (Earliest arrival noted: Oct, 12, 1889; latest spring date: April 2, 1895).

76. *S. socialis* (Wils.), Chipping Sparrow. Abundant summer resident. (Earliest spring arrivals. Apr. 8, 1887; April 1, 1888; April 14, 1889. Bulk arrived: April 11, 1887).

77. *S. pusilla* (Wils.), Field Sparrow. Summer resident, perhaps not quite as abundant as the preceding. (Bulk arrived: March 10, 1888; April 19, 1890).

78. *Junco hyemalis* (Linn.), Slate-colored Junco. Abundant winter resident. (Earliest fall occurrence: Oct. 1, 1886. Latest spring occurrences: April 6, 1895; June 7, 1890).

79. *Melospiza fasciata* (Gmel.), Song Sparrow. Resident, but in cold winters many migrate, at least from the higher, more exposed portions of the country. This is apparently our most abundant native bird.

80. *M. georgiana* (Lath.), Swamp Sparrow. Common migrant in the spring and fall. (Spring occurrence: March 23, 1886; April 21, 1888; April 13 to May 9, 1891; May 9, 1897. Dates of fall occurrences; Oct. 6, 1888; Oct. 5–18, 1890).

81. *Passerella iliaca* (Merr.), Fox Sparrow. Common migrant in the spring and fall. (Spring occurrences: March 17, 1885; March 16, 1886; Feb. 22 to March 21, 1888; March 15–28, 1889; March 2–9, 1890; March 10 to April 13, 1891; March 10, 1895. Have found it in the fall from the 1st to the 15th of November).

82. *Pipilo erythrophthalmus* (Linn.), Towhee. Common summer resident. (Earliest spring arrivals: April 1, 1886; April 27, 1887; April 20, 1889; April 18, 1891. Bulk arrived: May 1, 1887; May 6, 1888).

83. *Cardinalis cardinalis* (Linn.), Cardinal Grosbeak. Rather infrequent; I have observed it only in the spring and fall. It is quite

probable that it breeds in this vicinity, but I have never seen it in summer.

84. *Zamelodia ludoviciana* (Linn.), Rose-breasted Grosbeak. Infrequent migrant. I received, from a friend, two specimens in the flesh, Oct. 1, 1887, and I shot another May 5, 1888.

85. *Passerina cyanea* (Linn.), Indigo Bunting. Common summer resident. (Earliest spring occurrences noted: May 4, 1887; May 8, 1891; May 16, 1897).

86. *Piranga erythromelas* (Vieill.) Scarlet Tanager. Infrequent summer resident, in thick woods. (Earliest spring date, May 6, 1887).

87. *Progne subis* (Linn.), Purple Martin. Tolerably common summer resident. (Arrives in the spring about the first half of April).

87. *Petrocheliodon lunifrons* (Say), Cliff Swallow. Infrequent summer resident, more abundant during the migrations.

89. *Chelidon erythrogaster* (Bodd.), Barn Swallow. Abundant summer resident. (Earliest spring arrivals: April 21, 1886; April 12, 1887; April 7, 1888; April 21, 1889; April 17, 1891. Bulk arrived: April 28, 1886; May 2, 1887. All depart in the fall at or before the first week in October).

90. *Tachycineta bicolor* (Vieill.), Tree Swallow. I shot two specimens and saw two others on April 25, 1891, by the Brandywine, and saw another three days later in West Goshen. It is strange that it should be so infrequent here, while it is so abundant during the migrations in other portions of eastern Pennsylvania.

91. *Clivicola riparia* (Linn.), Bank Swallow. Infrequent migrant.

92. *Stelgidopteryx serripennis* (Aud.), Rough-winged Swallow. Common summer resident along the Brandywine.

93. *Ampelis cedrorum* (Vieill.), Cedar Waxwing. Common migrant in the spring and fall; a few breed here. I have seen it only once in the winter, Jan. 13, 1886. (Earliest spring arrivals: March 14, 1889; March 1, 1890).

94. *Lanius borealis* (Vieill.), Northern Shrike. A rather infrequent and irregular winter visitant, from November until the middle of March, but in 1890 I saw one as late as April 6th.

95. *L. ludovicianus* (Linn.), Loggerhead Shrike. I shot two adult males, March 28, 1895, in West Goshen (these are now in the collection of the Acad. Nat. Sci. Philada). This is the only published occurrence of this species in Chester Co., and the second, of late years, for eastern Pennsylvania.

96. *Vireo olivaceus* (Linn.), Red-eyed Vireo. Abundant summer resident, more numerous than any other species of the family. (Earliest

spring arrivals: May 9, 1887; May 10, 1888; May 4, 1891. Bulk arrived: May 13, 1887; May 12, 1888).

97. *V. gilvus* (Vieill.), Warbling Vireo. Common summer resident.

98. *V. solitarius* (Wils.), Blue-headed Vireo. Tolerably common migrant in the spring and fall. (Dates of spring occurrences: April 28, 1888; April 20, 1889; May 10, 1890; April 22, 1891. Fall occurrence: Sept. 23, 1890).

99. *V. noveboracensis* (Gmel.), White-eyed Vireo. Rather infrequent summer resident.

100. *Mniotilta varia* (Linn.), Black-and-White Warbler. Abundant migrant in the spring and fall. I have never found it in the summer, though several nests have been taken in this county. (Spring occurrences: May 7, 1887; May 3–17, 1890; April 25, 1891; May 2, 1897. Fall occurrences: Aug. 24 to Sept. 9, 1887; Aug. 21–28, 1888; Sept 28, 1889; Sept. 6 to Nov. 29, 1890).

101. *Helmitherus vermivorus* (Gmel.), Worm-eating Warbler. Infrequent summer resident; it is no more abundant during the migrations. (Arrives about the second week in May).

102. *Helminthophila pinus* (Linn.), Blue-winged Warbler. I have seen this species only once, when I secured a specimen in West Goshen, May 17, 1890. It must be considered rare in this immediate neighborhood. Subsequently (May 9, 1897) I saw another.

103. *H. chrysoptera* (Linn.), Golden-winged Warbler. One male, May 5, 1897).

104. *H. ruficapilla* (Wils.), Nashville Warbler. A not infrequent migrant in May and September.

105. *Composthlypis americana* (Dinn.), Parula Warbler. Abundant migrant. (Spring occurrences: May 6–10, 1888, May 3, 1890; May 4, 1891. Fall occurrences: Sept. 18–20, 1889; Sept. 23, 1890).

*(To be continued.)*

## ENTOMOLOGY.[1]

**Protective Value of Motion.**—Mr. F. M. Webster in an address delivered before the Ohio Academy of Science and afterwards published in the Journal of the New York Entomological Society[2] makes some interesting remarks on the protective value of action, volitional or other-

[1] Edited by Clarence M. Weed, New Hampshire College, Durham, N. H.

[2] Journal of New York Ent. Soc., V. 67–77.

wise, in "protective mimicry." After citing a number of remarkable cases more or less well known he remarks, "Now in all these phenomena we have form and color supplemented by action, the object of all of which taken together is the protection of life. * * * * It was Mr. Bates who wrote in his "Naturalist on the Amazon," that "on the wing of the butterfly is written, as on a tablet, the story of the modification of the species, so truly do all the changes register themselves thereon," and it seems to me that in the brains of so-called "mimicing" species of insects, we might, if we could but understand the full significance of the brain cells, read therein the records of the development of a dim, obscure consciousness, a volition and an intelligence that has kept pace in the requirements of these organizations in protecting their lives and perpetuating their race. Man himself comes into the world, little less than a mere automaton but with an inherited basis for future developments of an individual consciousness, he begins his education with the alphabet but does not transmit even a knowledge of this alphabet to his children, who must begin precisely where he himself began. But there has descended to his children that which will enable them to master the alphabet with more aptitude and less difficulty. Now if we descend the line of animal life until we reach these insects whose movements go far toward perfecting the protection afforded by their form, color and coloration, may we not expect to find the foundation for a "species consciousness" that will enable their possessors to protect their lives from enemies of long standing, and gradually, though perhaps very slowly, adapt themselves to shunning the attacks of more recent foes. Or, to put it in other words, with a protective appearance, will there not go either a consciousness of that appearance or an inherited foundation for such a consciousness that will better enable an insect to apply its protective inheritance, and in the use of all these as a means of perpetuating its kind, follow strictly in the line of all other animal life?"

Among the most wonderful cases of "protective resemblance" noted was that of the moth *Alaria florida* "which conceals itself during the day in the withering blossoms of the Evening Primrose *Cenothera biennis.* The inner two-thirds of the wings of the moth are bright pink while the outer third, hind wings and abdomen are pale yellow. The moth enters the flower before day with its body resting on the style, the four parted stigma projecting beyond the tip of the abdomen, appearing like a part thereof, and when the sun appears the two petals that were above the moth soon wilt and fall down over the roof like wings, concealing the rose colored portion and leaving the yellow part exposed as a part of the blossom and so effectually is the moth concealed in this

way during the day that only a trained eye can detect its presence, and then only with extreme difficulty." The moth mentioned is very common in central New Hampshire though it appears to be either very rare or unknown nearer the sea and I have observed hundreds of specimens in the position described. The deception is certainly well carried out though not in every case so fully as described by Mr. Webster but the larva is even more closely concealed.

I had read that it was to be found feeding on the seed pods of the Evening Primrose and had several times looked for it in vain until one day I discovered a specimen in the act of backing out of the hole which they excavate in the pod, by gnawing a hole in the side and then eating the more juicy seeds. I broke off the whole stalk and was carrying it home when I noticed that there was a second caterpillar resting between the pods and resembling them so wonderfully both in shape and size as to escape my notice. I then began to examine the head more closely and to my astonishment I found seven others resting in a similar manner. I thought I had seen them all then, but on looking in the breeding cage in which I had placed them, two or three days after, I found the stalk so wilted as to be unpalatable to the caterpillars and no less than eleven were wandering around the sides of the cage. The other two were doubtless in the same position as those seen but were overlooked even in a close inspection. There is the possibility that they may have been in one of the hollowed pods but it is not at all probable as they would have had much difficulty in completely entering one.—W. F. F.

**Ambrosia Beetles.**—In the year book of the Department of Agriculture for 1896, Mr. Henry G. Hubbard has contributed an article of more than usual interest to the general reader on the habits of the "Ambrosia beetles." These beetles which are quite small and resemble their relatives the bark boring Scolitidæ, differ from all other known wood boring insects by not feeding on the wood itself but on a fungus which grows on the interior of their burrows.

Their galleries may easily be known from wood feeding species by being clear from bits of wood or other refuse and being black on the inside as though burnt with a hot wire. These galleries are usually excavated by the female but in some instances she is assisted later by the young larva.

The food fungus, or "ambrosia" does not "make its appearance at random in the galleries of the beetles. Its origin is entirely under the control of the insect. It is started by the mother beetle upon a care-

fully packed layer or bed of chip, sometimes in the bark but generally at the end of the branch galley in the wood."

In some species the ambrosia is only grown in certain chambers of peculiar construction. In many species it appears to be necessary that the sap of the tree should be in a state of ferment and the beetles will sometimes attack wine and ale casks. "In the care which they give their young and in the methodical and complex provisions which they make for the welfare of the colony, these beetle display the characteristics of true social insects, such as are known among bees, wasps, ants and termites, but which have not hitherto been found to exist among any other representives of the order Coleoptera."

The eggs of some species are laid in clusters of ten or twelve loosely in the galleries, and the young wander freely about feeding on the ambrosia. In other species each larva is contained in a cell of wood the excavation of which is began by the mother but completed by the partly grown larva. In this case they are fed by the mother beetle who keeps the entrance to this cell closed with a plug of ambrosia. The males of some species are small and wingless and fertilization of the female takes place in the burrow. In others the male is large and winged and accompanies the female in her flight to found new colonies. Should the number of beetles in a colony be diminished by accident or disease the food fungus soon chokes up the galleries and remaining inhabitants soon die of suffocation. In the case of the wingless males this would soon take place when abandoned by the females did they not unite in certain galleries and by keeping the fungus cropped, prolong for a time their useless existence.—W. F. F.

**The Brown-Tailed Moth.**—There has recently been formed in England a "committee for the protection of insects in danger of extermination" and a list of the species which they desire to protect has been published. Among them, are a few species like *Melitæa athalia* or *M. cinxia* or *Lycæna arion* which are perfectly innoxious and confined to a few isolated localities, for which it would not be unreasonable on the part of the true butterfly lovers to ask for protection against "pot hunters" or those who collect them merely for their value for sale or exchange. But there are others on the list and among them the "brown tailed moth" (*Euproctis chrysorrhœa*) which will probably be included in the next list of American lepidoptera.

In a late bulletin Prof. C. H. Fernald has given the history of this species in America with a short history of its life and descriptions of its stages. The moth itself belongs to the same family as the Gypsy moth,

Tussock moth and several other less known species. They are pure white with a silky lustre and a reddish-brown tuft at the end of the abdomen from which arises the common name. The young larva pass the winter in a nest made by drawing together a few terminal leaves of a twig and lining and surrounding them with a mass of silken threads. It is not known exactly when or how it was introduced into America but it has been noticeably injurious for at least four years and it is possible that it may have been imported with some foreign stock. It is at present confined to a small area in the vicinity of Boston.—W. F. F.

## EMBRYOLOGY.[1]

**Spinning in Serpula Eggs.**—In a paper[2] published in the Journal of Morphology, G. F. Andrews described remarkable and hitherto unrecorded phenomena in the eggs and larvæ of star-fish and sea-urchins and designated them filose protoplastic or "spinning" activities.

These "spinning" phenomena may be described as the formation of filaments extending out from the surface of the egg or cell and either straight, curved or bent; either separate or united to others; either simple or variously branched; attached at the base, and either free at the tip or attached there also—to the egg membrane, to other filaments or to the surface of some other cell. What makes these threads recognizable as living protoplasm is chiefly the character of their activities. They are *spun* out from the living egg or cell as are the filose pseudopodia of such creatures as Gromia, or as some of the pseudopodia of the leucocytes of certain Invertebrates. The processes are seen to grow longer or shorter, to branch, to join onto and fuse with others; they grow thicker or thinner, and often show nodular enlargements that pass along as in currents of living protoplasm.

Such filose spinnings connect the egg with its membrane, the cleaving cells with one another, and the polar bodies with adjacent cells or with the unsegmented egg. They traverse the cleavage cavity and put cells of ectoderm, entoderm and mesoderm into communication with cells of the same and of other germ layers.

Such intercellular connections are temporary, made and remade; they spin out as a cell is separating from its fellow in division and are not seen when the cells are closely pressed together.

[1] Edited by E. A. Andrews, Baltimore, Md., to whom abstracts, reviews and preliminary notes may be sent.

[2] See the AMERICAN NATURALIST. No. 363, March, 1897, page 242.

Having been shown these phenomena both in living and in preserved echinoderm eggs I was able to find them again in the common Annelid, Serpula;—though as yet by no means as clearly and extensively as in the more thoroughly studied and favorable star-fish material.

The egg of Serpula is much less favorable than that of the star-fish, as far as the seeing of spinning phenomena is concerned, since it has a thick, very highly refracting membrane that makes it difficult to see fine structures within it, and since also the cells are so closely crowded together and against the membrane (which remains as the larval cuticle) that there are few free spaces which could be traversed by spin threads.

Yet some filaments can be seen passing out from the egg, or cells, to the membrane. As yet I have not seen spinning filaments connect one cell with another though there was evidence that such probably exist and are to be seen with good light and favorable point of view.

When the polar bodies have been formed, the membrane is raised up from the egg sufficiently to leave a space all about the polar bodies. Though at first no processes are seen, they gradually form and extend out from the egg till they cross the space and become attached to the membrane. These processes are unmistakably the same as the spinnings of the star-fish egg. They are of different lengths and thicknesses and arise from the surface of the egg all around the polar bodies. The polar bodies were not seen to spin.

In cases where the egg-membrane is raised up locally at the end opposite to the polar bodies, spin-threads were also seen passing from this side of the egg to the raised membrane.

In abnormal individuals where the membrane is widely separated from the egg, long and very numerous and distinct threads were seen radiating out from the entire surface of the egg to the membrane. As in the star-fish there is a marked difference between the spinning of normal and abnormal eggs.

When the egg has divided into two cells and these are rounding off at the edges preparatory to the next division, spin processes are seen passing off from each cell to the membrane, both at the polar body pole and at the opposite end.

Here I first observed the branching of filaments, so characteristic in the star-fish. One common trunk arising from a cell presents a number of long branches that pass in various planes out to the membrane.

In later stages when eight or more cells are present, processes were seen, both in profile and in surface view, passing out from various cells to the membrane.

In the gastrula stage when the equatorial band of cilia is formed and the cleavage cavity nearly closed up by the elongated entoderm cells, spin processes were seen at the end opposite to the area of invagination, passing from the ectoderm cells to the membrane where it was slightly raised away from the ectoderm. Here also some movement and change of form was seen in a process, though not satisfactorily. Within the cleavage cavity a moving, pseudopodium-like process appeared to extend out from the entoderm toward the ectoderm, but it could not be seen clearly.

Some of these processes in Serpula, less difficult to see than the finest, presented enlargements, suggesting the probability of slow flowing of material along the process. The increase in number and length of filaments from a definite area under observation for a few minutes showed that they were gradually formed, and from the egg outwards.

Owing to poor light no higher than 8 eye-piece could be used with 2 mm. objective, so that it is probable many phenomena escaped observation.

The occurrence of such filose activity of the surface of the eggs of an animal so widely separated from the echinoderms supports the idea that such phenomena are universally properties of protoplasm,—an hypothesis put forth in a recent work[3] and based not only upon egg, and other, external spinnings, but upon numerous internal protoplasmic phenomena of the same nature, such as spinnings into alveoli of Bütschli's structure in both fluid areas and contractile structures, and contraction and strial displacements of the substance.

E. A. ANDREWS.

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## PSYCHOLOGY.[1]

**Some Experiments on the Tactual Threshold for the Perception of Two Points.**[2]—The term "space-threshold" was applied by Fechner to the distance which two small points must be apart in order to be perceived as two. Weber had already devoted

[3] The Living Substance as Such and as Organism. G. F. Andrews. Gnin & Co. Boston. August, 1897.

[1] Edited by Howard C. Warren, Princeton University, Princeton, N. J.

[2] The first group of experiments described here were reported in the *Philosophische Studien*, 1897, XIII, 163-222, reprinted in *Princeton Contributions to Psychology*, II, 1-60. The second group, viz., those with successive stimuli, will appear in an early number of the *Psychological Review*.

much time to the determination of this distance for different spots on the skin, for he found that the two points must be farther apart, to be felt as two, on some spots than on others. On the bicepts muscle of the upper arm, it is 66 mm.; on the volar side of the forearm, 40 mm.; on the tips of the index fingers less than 2 mm., etc. Many questions arose and many investigators have busied themselves with them; but a number of questions in this field, in spite of the numerous books and articles on the subject, have in some cases received no attention, and in others have not been answered. With the exception of one article, the question as to the threshold for the perception of spatial difference in the case of two *successive* stimuli has never been raised. In experiments with two simultaneously stimulating points, it has long been known that the distance which two points must be apart in order to be perceived as two at any one spot of skin can be reduced in a very marked degree by practice. It was further noticed by Volkmann and Fechner that when this distance is reduced by practice on any one spot, the threshold for the symmetrically opposite spot on the other side of the body undergoes a like reduction without being practiced. These investigators gave a purely physiological explanation of the phenomenon, viz., that the centre in which the two sets of fibres (those from the symmetrical spots) meet is the seat of the change which causes the reduction. Their experiment was not, however, so planned as to test the question whether a similar reduction of this threshold occurs over the entire body.

Our first duty was to undertake a series of such experiments. These were carried out by the writer at the Leipzig Psychological Laboratory. As a result, it proved to be true that the same reduction does occur over the entire body whenever it occurs on any part of the body, and this result points directly to the inference that the whole phenomenon demands a central explanation based upon central psychic processes. But in connection with these experiments several singular phenomena came to light. (1) Not all subjects showed the reduction of the threshold by practice: in fact, it occured only in the cases of those who knew beforehand what the problem was and what results had been hitherto reached by others. In cases where the subject did not know these facts and did not surmise them from the nature of the experiments, no reduction whatever occurred. (2) In all cases where the reduction occurred, there appeared as one result of the practice an increase in the frequency of the illusion called by the Germans *Vexirfehler*, i. e., where the subject senses two points when touched by but one. In cases in which the series began without these illusions, as

with some subjects, the illusion developed after some practice in the experiments. This illusion sometimes becomes so frequent that no thresholds can be determined; the subject answers, in response to all stimuli, whether of one or of two points, "two points." (3) A long series of experiments showed that this illusion is, for the most part, a result of suggestion of some kind; a suggestion which the subject gets either from the operator, from the nature of the experiments, or by auto-suggestion. It was found that the frequency of the illusion, and even its occurrence at all, could be influenced to a marked degree by suggestion. In some cases the illusion could be prevented by the subject's discovering the suggestive influence and freeing himself from it. (4) Subjects were found who, to start with, gave constant thresholds as long as nothing was suggested to them in regard to the object and method of the experiments, but by a suggestion from the operator, they were led to show a very rapid reduction of the threshold. Afterward, by freeing themselves from the influence of the suggestion, they returned, in some cases, to the old constant threshold, freeing themselves at the same time from the illusions which had developed as one result of the suggestion.

All of these facts go to indicate that both the reduction of the threshold by practice and the illusion of two points are the results of suggestion in some form. In every instance of the perception of space relations by touch, there seems to be involved a process of assimilation in which a visual or motor image is the assimilating, and the tactual sensations the assimilated, elements. In ordinary life, we test continually our tactual sensations by visual images, turning the eyes to look at the spot touched. In these experiments this was rendered impossible by the fact that the subject could not see the spot on which the experiments were performed, as this was concealed from him by a screen. Hence the place of these images is supplied by memory images connected with the tactual sensations by past experience, i. e., by association. In our experiments the assimilating visual or motor copies of past experiences are not called up by the association with the tactual sensations alone, but are suggested by other factors. In the localization of a single point, the "local sign" involved is not to be conceived of as a simple quality of the tactual sensation, but is rather a relation of association between the tactual sensation and some visual or motor image.

Another series of experiments was undertaken in the Princeton Laboratory by Dr. C. W. Hodge and myself, in which the two stimuli were successive, instead of simultaneous, as in the above experiments.

In each series of such experiments, the first point touched each time remains the same, the problem being to determine the distance from this point at which the two stimulations seem to be spatially different, and the distance at which the direction of this difference is first recognized. These two determinations may be called the thresholds for *difference* and *direction* respectively. In the results it is found that the subject, as a rule, mistakes the direction of the second point from the first after he has apparently become aware that the two points are not the same. The inference has been drawn that the difference threshold is shorter than the direction threshold. But a careful study of the answers given seems to show that this apparent recognition of difference without direction is again due to suggestion. This entire group of experiments seems to sustain the inferences drawn in the former group as to the ultimate nature of the process involved in all tactual space perception. It is an assimilation process throughout, in which visual, tactual and motor elements play the most important parts. In cases where, as in these experiments, an extensive and rapid reduction of the threshold, and a development of frequent illusions of the kind described, occur as the result of practice, the explanation of these phenomena is to be sought, not in any change in the physiological structure or functions of the tactual end-organs, nor of the centres with which these end-organs communicate, but rather in a process through which suggestion-influences get established in the reactions of the subject's attention.—G. A. TAWNEY, *Beloit College, Wisc.*

**The Annee Biologique.**—The new annual which has been started by Yves Delage under this title has adopted a broad policy with reference to psychology. The first number (that for 1895) has just appeared, and we are pleased to note that a large section, of over 100 pages, is devoted to this department under the head of "Mental Functions." A portion of this space is taken up with an able review of recent theories of the structure of the nervous system, by Mlle. W. Szczawinsky, but most of the section lies within the domain of psychology proper. Prof. Binet furnishes a review of the development of experimental methods, which, though necessarily brief, contains a fair résumé of the change that has come over this field within the past few years. He sums up, in particular, the work on memory, the æsthetic sense, and the physiological concomitants of mental activity, where considerable progress was made in the year 1895. The remainder of the section consists of summaries by various writers of the leading works and articles which appeared during that year. These are, in some cases, very full; about sixty contributions are noticed in all.

As the scope of the *Année* is purely biological, psychologists have certainly no ground to complain of the treatment which their science receives: the entire section is conceived in a spirit entirely friendly to its claims as a distinct science, and is written for the most part by persons who rank high in the department. If any criticism were to be offered, it would be that it is not perfectly clear why certain departments of psychology that are not mentioned do not deserve treatment in this connection fully as much as certain others that are admitted. But to suggest this would be to look a fine gift horse in the mouth, and we can do no better than express our delight at the whole-hearted recognition which the older science has here accorded to the newer. It is to be hoped that the plans of the *Année biologique* will not be altered in this respect, and that in future the psychologist may always be able to trace the progress of research on the biological side of his department by simple reference to the pages of this annual.—H. C. W.

## ANTHROPOLOGY.[1]

**The Tomahawk of the North American Indian.**—In regard to your inquiries concerning tomahawks in the United States National Museum I would say that, in order to understand their structure, their function and the places which they supplied in the armory of the Indians of the United States it is best to remember the following facts: Aborigines of this Continent seem to have understood all the ways of killing men and animals. Before the discovery they used both poison and fire to take life, and they had the three great types of weapons, namely: for bruising, for piercing and for cutting. Adrien de Mortillet somewhere calls attention to the additional fact that each one of these classes of weapons, to-wit: bruising, piercing and cutting, is used in the hand, at the end of a handle, or thrown from the hand. You will see that underlying this division of Mortillet's we have three methods of applying force. First, directly utilizing the explosive force of human muscle. Secondly, the additional impetus given to a weighty weapon by affording it a longer excursion in the air and the added element of safety in that by means of a long handled bruiser, piercer or cutter the attacking one produces his effect at a greater distance from himself. The ballistic weapon, seldom thrown from the hand alone, acquires its velocity and additional force by means of a sling, throwing stick or a bow.

[1] This department is edited by H. C. Mercer, University of Pennsylvania.

With this analysis in hand let us return to the tomahawk; it is a compound weapon, having for its function both bruising and cutting. It is also a handled weapon. The addition of the pike to the poll of the tomahawk is simply one of those delightful transitions which all industrial things undergo in passing from the useful into the ceremonial and mythic condition. In the aboriginal times tomahawks had no pike attachment.

The iron tomahawks in the United States National Museum are of two distinct classes: the one has an edge like a carpenter's hatchet, the other has a point and so belongs rather to the striking-piercing than to the striking-cutting apparatus of the northern type. So far as the record of these instruments go, the broad-edged, hatchet-like tomahawks were first sold to the Indians by the English and Dutch, while those with the pointed blade came through the Spaniards and the French or through southern or Latin Europeans. Indeed, the blade of this tomahawk is that of a pike and is bent at right angles so as to work with a blow rather than with a thrust.

Now, according to universal usage of savage peoples, they usually accept from civilized traders those things which supply a "long felt want." This "long felt want" is usually, both in practical life and in scientific pursuits, the consciousness of a mechanical incapacity or weakness. Very frequently the artisan knows what he wants, but he has not the practical skill to invent it. The savages of this country, then, exploited the tomahawk and took it in lieu of something they were using, but which was far inferior to their desires in this direction. For their bloody work the hatchet-tomahawk or the pike-tomahawk was a boon.

The weapons of this class which preceded the metallic ones were made of antler, in which the long prong furnished the handle and the shorter prong the working portion with or without the addition of a sharper point. In countries where the elk-horns of heavy antlers were not procurable, and good working hatchet blades of volcanic stone could be procured, the tomahawk was simply a celt or grooved blade set into a handle by one of the many ways by which hafting was formerly done.

In considering, therefore, the great mass of so-called celts and grooved axes, it must be understood that while a portion of them were industrial tools with the savage artisan, many of them were a striking-cutting weapon attached to a handle to enable the warrior to do his work at a short distance.

A most efficient form of the striking-cutting weapon was the Mexican battle-axe, consisting of a handle of wood along the edges of which spalls of obsidian and rugged stone were set. In some instances these chipped blades were placed so close together and in such regular fashion as to suggest the first steps in the invention of the sabre which is a striking-cutting weapon.

Some of the Siouan tribes of the Missouri River, in later days, inserted heavy spikes or blades of butcher's knives and other blood-curdling objects, doing their work precisely after the fashion of the Mexican axe.

In the Antillian area and over nearly all of South America north of the parallel of Rio Janeiro, the blades of the tomahawks and battle-axes were exquisitely fashioned and polished.—Otis T. Mason.

**A Triple Indian Grave in Western New York.**—On September 10, 1885, I opened an Indian grave which was of interest in many ways. In the first place, it was located near the site of Ganagarū, which was, for many years, the principal village of the Seneca nation, and for which they seem to have had an unusual degree of pride and affection. This village was destroyed at the approach of De Nonville's invading troops in 1687, and was never rebuilt, perhaps from sentimental motives. This village site occupies an area of at least ten acres, and is still marked by burnt soil, chips of chert—brought from a distance—fragments of pottery and of clay pipe-stems and even more perfect relics. During the early days of the American village of Victor, the settlers depended for old iron largely upon the lost tomahawks of the Indians, and quantities of French glass and wampum beads, of chert and brass arrow-heads and of many other relics, attest the richness of this Indian capital.

During the spring of 1885, Mr. George Ketchum, residing near Victor, plowed out a brass kettle and a few bones from the brink of a slight fall of land. It is at such places as this that the plow is most likely to detect ancient interments, the earth being gradually carried down hill so that after the lapse of years, the original grade has been so changed that the plow hooks into a skull, throws up a long bone, or tears out some article deposited with the skeleton.

At my visit, it was comparatively easy to expose the remaining contents of the grave. The bones of the skeletons were not all present, suggesting either that they had been disturbed by burrowing animals or that the interment had been made after prolonged exposure on an aerial scaffold as was practiced almost uniformly by many tribes, and,

to some extent, by the Iroquois. In burials after exposure on scaffolds, however, a dozen or twenty bodies were usually collected and interred almost without relics and in a very limited area. Other burying places were noted in the same field, but at much greater distances than usual.

While it was impossible to ascertain the exact attitude in which the bodies were laid, all of the heads pointed toward the west, and the mummy position, so frequently noted in graves of the Iroquois, was not apparent. Of the three skeletons, one was conspicuous for its development, though not for its height. The femurs showed a "third trochanter" almost as plainly as do those of the horse, while, in most human skeletons, this projection has become merely a roughening of the bone. The skull showed the lines of muscular attachment as I have never seen on another, and, in general, it was evident that this warrior must have been a person of tremendous physical development. The comparatively open sutures of the skull showed that he was still below middle age, though fully matured. The second skeleton was that of an adult of moderate build and apparently older than the first. The third skeleton, which was very incomplete, was that of a small child. The molars, which are usually cut in the sixth year, were not quite out of the bone of the jaws.

At the neck of the first skeleton, so as to discolor the upper part of the breast bone and the first ribs, was a string of brass beads. These had oxidized, and the verdegris had preserved the leathern string on which they were worn, so that the loose single bow-knot, tied many years ago, has remained intact. A number of red stone beads had fallen away from the neck and lay at the level of the bottom of the grave. These were square on section, of about an inch in length, and some were nicked or rudely ornamented. They appeared to be made of the western pipe-clay; at any rate, they were of material not found for many miles about the site of the grave. A pipe-stem, of the clay of the vicinity, was found near this skeleton, and at the feet was a brass kettle. At the feet of the second skeleton was another kettle and part of an iron knife, rusted almost to disintegration. With the child's skeleton was found a brass sleigh-bell. Besides these relics must be counted the kettle plowed out of the grave in the spring.

Within the kettle found near the feet of the second skeleton was a mass of vegetable fibre resembling moss. A similar mass found in a kettle buried with a skeleton at the village site mentioned, showed a right-angled crossing of some bands of fibres, and strongly suggested that the decayed vegetable tissue had been a basket or some similar plaited receptacle.

It is possible to compute the age of this interment within somewhat wide limits. Articles of European manufacture had not become common among the Senecas of this region till within quite a short time of De Nonville's expedition. On the other hand, the history of Victor goes back about a hundred years, so that it is practically certain that this grave is not earlier than 1650 nor later than 1800. So far as could be judged by the appearance of the bones—by comparison with others in which some idea of the age of interment may be formed—and by the state of preservation of the relics, the remains date back of English influence and come within the period of French influence, somewhere about the close of the seventeenth century.

The grave referred to as opened at the site of the village of Ganagarŭ, was described in the NATURALIST several years ago. The skeleton was that of a young person, the wisdom-teeth not having been fully developed and the bones being immature, though nearly of adult size. The body had been put or had been left in the "mummy attitude," with elbows and knees bent at the sides of the trunk. Strangely enough, the remains were found head downward. With this skeleton rested that of a turtle—perhaps indicating the clan of the deceased—thirty feet of French glass beads, ninety feet of wampum, a brass kettle, a bone head-comb, showing in silhouette, the figures of a man on horseback and of another person standing behind him, and other ornaments. These would seem to indicate that the person was a woman, and doubtless a young lady of distinction, from the wealth buried with her.

Other burials in the same vicinity have shown somewhat similar relics, and belong to the period when the wares of the French traders were mingled with the weapons and implements of the Stone Age.

A. L. BENEDICT.

## SCIENTIFIC NEWS.

Mr. J. E. S. Moore has an interesting sketch of some of the faunal features of Lake Tanganyika in *Nature* of July 1. He concludes "that the fauna of Tanganyika is comparatively old, for it is unlike anything now inhabiting the sea, and if it is derived form a previous freshwater stock, much time would be required for the evolution of its widely divergent present forms."

The natural history building of the University of Illinois, dedicated a few years ago, was struck by lightning on June 17 and partially de-

stroyed. The greatest damage occurred in the botanical and geological departments; the library and the zoological collections were but slightly injured. The total loss is estimated at $8000.

Dr. James Ellis Humphrey, Associate Professor of Botany in Johns Hopkins University, died in Port Antonio, Jamaica, August 17, at the age of 36. Dr. Humphrey had agreed to be one of the Botanical Editors of the American Naturalist, under its new management. A sketch of his life will appear in our next number.

The recent appointment of Mr. Ernest William MacBride, fellow of St. Johns College, Cambridge to the professorship of zoology in McGill University, Montreal, marks a distinct step in advance in that institution. Professor MacBride is well known through his researches on the embryology of Echinoderms and Batrachia.

Dr. Japetus Steenstrup, until 1885 professor of zoology in the University of Copenhegen, has just died. He was born March 8, 1813. His work was largely in the line of marine zoology and his essays on hermaphroditism and on alternation of generations attracted wide attention in their day.

The efforts made to have natural history specimens admitted to the mails of the Universal Postal Union has met with partial success in so far that these objects are now classified as samples and are charged postage at the rate of one cent for every two ounces.

The plans and significations for the new wing of the American Museum of Natural History in New York, have recently been approved and bids for the construction of the addition are now being received.

A new journal is the Annotationes Zoologicæ Japonensis. The first number contains a short but interesting sketch of biology in Japan by Professor Mitsukure.

The Cagnola prize of $500 and a gold medal have been awarded to Prof. Ferdinando Sordelli for his memoir on the vegetation of Lombardy in geological time.

Nearly 300,000 francs has been subscribed to the fund for a monument to Pasteur in Paris. The commission for the statue has been given to M. Falguières.

Professor H. W. Conn of Wesleyan University will spend next year in Europe. His biological courses will be conducted by Mr. Estin during his absence.

Professors Wilhelm His and A. Ramsay have received the hounorary degree of Science from the University of Dublin.

Mr. A. W. Bennett succeeds Prof. T. Jeffrey Bell as editor of the Journal of the Royal Microscopical Society.

Professor Sollas of Dublin, goes to Cambridge as successor to the late Professor Green in the chair of Geology.

A zoological club has been organized at Springfield, Mass. with a membership of nineteen.

Prof. T. W. Engelmann of Utrecht, goes to Berlin as Professor of Physiology.

Professor Leuckart has been made a Knight of the Prussian Order of Merit.

THE LAST PHOTOGRAPH OF PROFESSOR COPE.

*Taken by Dr. F. C. Robinson at the Buffalo Meeting of the American Association for the Advancement of Science, 1896.*